NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER ATL--ETC F/G 1/2 LOS ANGELES INTERNATIONAL AIRPORT DATA PACKAGE NUMBER 10, AIRPO--ETC(U) JUN 80 AD-A099 863 UNCLASSIFIED NL

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LOS ANGELES INTERNATIONAL AIRPORT, DATA PACKAGE MA 10.

AIRPORT IMPROVEMENT TASK FORCE DELAY STUDIES.

Jun 84 **24R**

JUNE 1980

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DATE: July 18, 1980

SUBJECT: Revisions for LAX Data Package No. 10

PROM: John Vander Veer, ACT-220

TO: Members of the Los Angeles Task Force

Enclosed are the revisions for Los Angeles International Data Package
No. 10. The replacements are for pages 23, 25, 40, 46, 47, 55, 56, 59,
60, 64, 65, 69, 77 and 78.

The changes in annual delay were the result of a miscalculation and the other changes were the result of transcription.

John Vander Veer

TABLE 9

RESULTS OF VFR -- WESTERLY FLOW

EXP. DEMAND ARRIVAL	15	MINAL	DEPARTIES	TATE OF THE PARTY													•
DEMAND	DEMAN	6 2		REACUTED SEPARATIONS SEPARATIONS	SEPARATIONS	RUNNAY	TAXI	(minutes)		RUNWAY TAXI R	I (minutes)		TOTAL	Ţ	TRAFE TIMES	(minutes)	
						AIR		X-ING			X-ING	4	DELAYS	AKKIVAL	ARRIVAL Ground	DEPARTURES Cround	TOTAL
9		·	1	NONE	1978	803	*	80	2772	482	٧	7.	3477	4077	1529	2677	//283
1182	11	. [-	None	1978	634	57	10	25%	252	0	30	3336	4027	9/3/	6	2
1962			1	NoNE	8261	15%	99	1119	4/82	897	+	293	557.2	233		3639	11476
1982				None	1978	25.71	726	105	5541	123/	4	8///	8587	333	1907	1905	14736
182		j	-	NEAR TEAM	1982	/358	123	801	4/30	/357	4	3	6856	4709	///	1000	15.0
1982			SENT PROM	NEAK TERM	1982	405	58	87	2048	464	8	0	3/06	3217	1031	4801	28251
1982			l	Aurent 244,	1882	436	19	88	2380	468	8	ñ	3026	26.95			20/2/
//72		_	.1	DUAL TAXIWAY	1982	2/5	\$	59	27.20	125	0	27	333/	31/4	//5//	7305	1923
1982	_ '		DEPARTURES SENT FRIM JSR TO AHR	DUAL TAKI WAY	1982	382	48	0,7	2277	185	01	18	2911	3786	1625	242	¥ 6
1982		,	=	DUAL TAXIWAY	1882	404	72	2	2190	623	०	2	2980	3748	1629	5175	10532
1987		1	1 .	TEAMINAL.	1978	525	39	254	2346	424	∞	ú	2873	3823	1586	5/5/	0250/
									_					_			

->= REVISION A, 7/18/80

•	'					2	RESULTS (OF IFR	i	WESTERLY FLOW	FLOW				٠		•	•
	KY.	DEMAND	EXP. DEMAND ARRIVAL DEMAND HODIFIED		DEPARTURES IMPROVENENTS AIR TRAFFIC REROUTED SEPARATIONS	AIR TRAFFIC SEPARATIONS	<u> </u>	ANRIVAL DELAY (minutes) RUNNAY TAXI RUNNAY	Minutes)	DE PAR	DEPARTURE DELAY	AY (minutes		TOTAL	TRA	VEL TIMES	TRAVEL TIMES (minutes)	
	Ŀ						AIR		X-ING		\neg	X-ING	31 1		ALR	ARRIVAL	DE PARTURES GROUND	TOTAL
. ——	<u> </u>	0///		1	News	1178	8235	36	8	2170	00/	۳	63	2424	11024	/3.24	45.14	
1	*~	1978	45/MM184 00/25/	გ— 	NON	1078	2444	,		1	1	1	1				T. C.	16871
	×		8 22 2				11.	3	09	54.07	128	4	315	3437	26/0	1548	2377	14755
	÷	1978	=	1	NONE	1978	7007	1054	40	1535	741	4	5305	16222	9970	2546	16754	207.20
)	× 0	1182	SOMMINES ON 252 CHAMBED TO 24 R	ſ	NonE	81.81	\$100	37	S	27/4	4	7	304	3288	6524	1578	25.7.8	
	2	725+	SJANNING ON 2 SL CHAFEE	ı	NoNE	1978	7945	36	35	3777	12	1.	1	43	1			0/1/0/
	88	1962	El AKRIVALS ON 25L CHANGEO	1	NoHE	1978	12 703	81	۲	2441	29.7	1		81.73	""	27.57	*///•	16511
			50 AKKWE									7	3	21.0	16030	1448	10000	26277
1	۲]	78	C.F. MOED		NEAR TERM	1982	5046	55	*5	2373	165	ຠ	223	2874	628	1594	4810	14632
	**	1987	50 1/4/145 0N 251 CHANGED	Sent From 25R to 24L	NEAR TERM	1962	2321	20	85	27/3	189	•	290	3307	3406	1665	244	135/5
	ম	1982	_	DEPARTMES SENT FRAM 25L TO 24/L	RUNWAY 25R TUNNEL CONSTRUCTION	1978	4776	13/	1,	5292	33,	^	43/8	9948	7353	1757	//341	20457
	24	1982	1	1	RUNNAY 25L TUNNEL CONSTAUCTION	1978	2367	108	18	6327	197	0	3/12	1466	5656	1893	11386	408CE
	24	1982	ı	SEMATURES SENT FROM 25R TO 24L		1978	Epa3	1/3	20	6020	394	0	#872	ЬЬНІІ	\$626	1161	13505	
	4											-						

* ORIGINAL ARRIVAL RUNWAY DISTRIBUTION OF TRAITIC DEMAND HAS BEEN MODIFIED

TABLE 14 (CONTINUED)

1978 OPERATIONS WITH 1982 DO-NOTHING CASE

																•	
-	P. DERKIN	DARRIVAL	DEPARTURES	EXP. DEHAND ARRIVAL DEPARTURES IMPROVEMENTS AIR TRAFFIC	AIR TRAFFIC	ARRIVAL'	סברעג (י	minutes)	DEPART	URE DELA	Y (minut	.(88	TOTAL	, TRA	VEL TIMES	(minutes)	
		DEMAND	DEMAND RENOUTED HODIFIED		SEPARATIONS	RUNMAY	TAXT	RUNWAY X-ING	RUMMAY	TAXI	RUNWAY X-ING	CATE.	CROUND	ARRIVAL	ARRIVAL GROUND	DEPARTURES Ground	TOTAL
	2 1978	2 1978 CHANGES		3W•N	1978 (CFR)	4444	35	35 60 2895 128	2885		+	315	3437	4 315 3437 7610	1548	5597 14755	11755
	\$ 1982	53 AA(17413 04 251 04 251 19 2 4 8		HOHE	1998IFR)	2100	39	٤3	63 2714	<i>\$91</i>	4	304	5 304 3288	8324	1578	8324 1578 5568 15470	15470

RESULTS: The 1982 denand resulted in greater arrival delays and reduced departure delays.

•	4255	5323
		1825 . 5523
	.994	442
	2112	3001
	1139	7307
	0	0
	0	•
	ک	51
	1130	1285
	0	0
	+	4
	1245	2046
	1978 (IFK)	1178(SER)
	Nine	Nonse
	ALL ALCUMALS PLACED OF	*
	1978	1982
	*45	, <u>§</u>

RESULTS: The 1982 demand resulted in greater arrival and departure delays.

* - Modified Demend

<- = REUISION A, 7/18/80

TABLE 17

1982 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND

1978 — 1982 — 1982 — 1982 — 1982 — 1982 — 1982	. 4 1 1	None		ARRIVAL DELAY (atmuces) RUMAY AIR 803 46 80 634 57 81 1576 66 119	the feet of the fe	RUNMAX X-ING 80 81 //9		482 482 562 897	RUNTAY X-ING X A A A A	# 4 0 X	[25일] ''' 저 시 서	GROWND DELAYS 3477 3477 5334	STAN A A A	TAL TRAVEL THES OUND ARRIVAL GROUND 1477 4077 1529 336 4027 1610 562 562 562 1708	TAL ARRIVAL ARRIVAL DEPARTUMES TOTAL LAYS AIR GROUND GROUND S477 4077 /529 5677 /1283 336 4027 /6/0 5659 /1296 562 523 /708 7905 4730
107		NonE	1978 (MFR) 5671 226	767/	726	105	105 5341 1591	1831	4		1118	1118 8587	1118 8587 9339	1118 8587 9339 1907	
1978 02.252 2 5 19 14 16		NowE	197 <i>8 (IFR)</i>	4444	35	9)	2895	128	4		315		315 3437 7610		3437 7610
1987 0425L 5411160 5411160	3 6	NoNE	1978(1578)	5/00	65	3	2714	164	4		304	304 3288	1	3208	3208 6524
1982 SAMMAL +5% CHAYEO	₹ C	None	1978 (IFK)	7945	36	55	3777	170	\	 	316	2546 916	1	2546	1811 2546
1982 CINKINKS 4157, ENINGED	<u> </u>	None	(ATC)8(F)	12703	10	25	5442	297	7		2205	8/13	8/53 /6830	8/13	8/53 /6830

TABLE 18

PEAK AVERAGE DELAY (AVERAGE DAY) (minutes)

	EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIM ARRIVAL	E DELAY DEPARTURE
-	1	1978	VFR	NONE	1978	5.3	12.7
ı	7	1982	VFR	NONE	1978	3.5	9.5
	7A	1982+ 57	VFR	NONE	1978	9.9	13.8
I	7B	1982+157	VFR	none	1978	35.7	16.9
	_ 2	1978	IFR	NONE	1978	25.7	12.5
	8	1982	IFR	NONE	1978	26.6	10.0
	8A	1982+ 57	IFR	NONE	1978	45.8	12.1
	. 8в	1982+15	IFR	none	1978	65.1	19.0
						•	
ſ							·

TABLE 20

1962 DO-NOTHING CASE WITH 1982 SEPARATIONS AND NEAR-TERM IMPROVEMENTS

AIR AIR TAXI RUNHAY TAXI RUNHAY CATE GROUND AIR X-ING X-ING DELAYS G34 57 81 2578 572 8 30 5536 405 565 58 87 2048 454 8 6 3100			AKKIVAL.	DEFARIUMES	EXP. DEMAND ARRIVAL DEPARTURES IMPROVEMENTS AIR TRAFFIC	AIR TRAFFIC!	ARRIVAL		minutes)	DEPART		Y (minut	<u> </u>	TAPE TAPE	ž	VEL TIMES	TRAVEL TIMES (minutes)	
7 1982 — NONE 19781VFR) 634 57 81 2598 582 11 1982 — 25x 70.248 TEKM 1982(VFR) 405 58 87 2048 494			DEMAND	REROUTED		SEPARATIONS	RUNMAY	TAXI	RUNWAY X-ING	RUNHAY	TAX1	RUNWAY X-ING	CATE	CROUND	ARRIVAL Atr	ARRIVAL Ground	DEPARTURES Ground	TOTAL
SENT FROM TERM 1982 (VFR	7	1962	f	1	None	_	634	23	18	2578	282	8	30	3336	4027	0/3/	5659	11296
l	1	1987	1	DEPARTURES SENT FROM 25K TO 29R	NEAK TEKM	1982(NFR)	405	58	87	2048	454	8	9	3106	3717	10.57	1084	00/0/
RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower arrival and departure delays.		ESULTS:	The NEAR-	TERM Improve	ments sad the		retions	result	ed in loa	me arriv	b bus is	eparture	delays.					

RESULTS: The high speed exits, runway 7L by-pass and the 1982 separations resulted in lower arrival and departure delays.

16519

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2755 3898 1602

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1271 309

29

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1982(VFR) 332

1982

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1982

50 72.

1595

3785

3302

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2370

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85

408

1978 (VFK)

None

3															170 4IN	1
12515	290 3307 5406 1665 5444 12515	1665	57.06	3307	290	9	101	58 2713 189	B	So	1252	1982 (SR)	WEAK	SANT FROM	182 CHANGE	12, 1/1
15470	5 304 328 8324 1578 5366 15970	1578	8324	3208	304	h	164	63 27/4 164	ß	39	FR) 5700	1978 (IER)	3No N		982 ON 25L	* 8
											·					

1

RESULTS: The NEAR-TREM improvements and the 1982 separations resulted in lower arrival delays.

* - Modified Demand

->= REVISION A, 7/18/80

TABLE 21

PEAK AVERAGE DELAY (AVERAGE DAY) (minutes)

	EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIM ARRIVAL	E DELAY DEPARTURE
	7	1982	VPR	NONE	1978	3.5	9.5
	11**	1982	VFR	NEAR-TERM	1982	1.6	7.5
	8*	1982	IFR	NONE	1978	26.6	10.0
	12*	1982	IFR	NEAR-TERM	1982	25.5	8.3
•	12**	1982	IFR	NEAR-TERM	1982	13.1	9.9
					•	~	
				,			
						٠.	
		·			•		
ſ	7		1				

* - Modified Demand

** - Rerouted Departures

TABLE 23

1978 OPERATIONS WITH 1967 SEPARATIONS AND LONG-TERM IMPROVEMENTS WARYING THE 1987 DEMAND

+		700 1000	DEPARTURES	IHPROVEHENTS	AIR TRAFFIC	ARRIVAL	DELAY (ninutes)	DEPART	URE DEL	IV (minut		TOTAL	AT.	VET TIME	TRAVEL PINCE (-Inne)	
		DEMAND MODIFIED	MEROUTED.	DEFAND REROUTED SEPARATIONS RUNALY TAXI RUNALY TAXI RUNALY GATE HODIFIED X-ING X-ING	SEPARATIONS	RUNWAY	TAXI	RUNWAY X-ING	RUNNAY	TAXI	RUNWAY X-ING	CATE	CROUND AND	ANATVAL	ARRIVAL	CROWND ARRIVAL ARRIVAL DEPARTURES TOTAL	TOTAL
7	1778	1	J	NonE	None 1978 (YEA)	803 46	4	80	80 2792 482	482		K	3477	4077	1529	74 3477 4077 1529 5877 11283	11283
25 1987	1321		1	FAR	1987 (VFR) 189		45	32	34 32 1325 245	245	_	7	1639	3720	1452	2 1639 3720 1452 3519 8193	8 192
254 1987	10 72	1	ı	FAK TERM	1887(VFR) 257 40 38 1957 415	257	. 64	38	1957	4/5	-	22	*257	3819	1585	73 2524 3819 1505 4455 9859	883

The FAR-TERM improvements and 1987 VPR separations resulted in substantial reductions of arrival and departure delays.

_		OK ALENDAS															_
۲,	878	ON 25 L		NoHE	1978 (1778)	4444	35	9	2815 128	128	+	315	315 3437 7610	26.70	1548	1548 5597 14755	14755
_				27.2													
7	1187	1	1	757	1 4 P 7/TER	0 2 1	,		,633	9	,	,			1		
				וצמוש	Survey -	20	2	2	7.4.5	8	4	11	2/20	2150 4392	15/1	15/7 40/0	. 9.920
_																	

RESULTS: The FAR-TERM improvements and 1987 IFR separations resulted in substantial reductions of arrival and departure delays.

* . Modified Demand

7= REUISION A, 7/18/80

TABLE 24

PEAK AVERAGE DELAY (AVERAGE DAY) (minutes)

	EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIM ARRIVAL	E DELAY DEPARTURE
•	1	1978	VFR	none	1978	. 5.3	12.7
	25	1987	VFR	FAR-TERM	1987	0.6	5.0
	25A	with 1987peaks	VFR	FAR-TERM	1987	0.9	7.9
	2	1978	IFR	none	1978	25.7	12.5
	26	1987	IFR	FAR-TERM	1987	4.6	7.0
					•	<u>.</u> .	
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L							
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->= REVISION A, 7/18/80

TABLE 26

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

<u> </u>	КР. DZHA	ND ARRIVAL DEMAND	DEPARTURES REROUTED	EXE, DEMAND ARRIVAL DEPARTURES IMPROVEMENTS AIR TRAFFI DEMAND REROUTED	AIR TRAFFIC SEPARATIONS	ARRIVAL RUNWAY	DELAY (minutes)		DEPARTURE DELAY (minutes)	AY (minut	7.00	TOTAL	TRA	VEL TIMES	TRAVEL TIMES (minutes)	
	-	MODIFIED				AIR		X-ING			X-ING	4		AIR	CROUND	CROUND	76107
	7 1982	1	1	NONE	1970 (VFK)	489	57	18	2598	275	8	30	3336	0191 1200	0/9/	8535	11296
لتا	22 1802	1	DEPARTURES SENT FROM 25L TO 24 R	RUNWAY ZSA TUMMEL CONSTAUCTION	1970(VFR)	993	233	13	4200	1450 11	*	446	1857	944 6857 4403	3/00	38551 2806	15536
	224 1982	7	"	GUNIWAY 25K CONSTRUCTON WITH 1978 (MFR) 1034 DUAL TARIWAY	(878 (1958)		187	"	11 13.59 11	13.59		8401	1699	1012 4444 4899	7012	1006	15547
	35 /19	1902 SOAANIVAL CHANKLO TO 249	SO AAANALS DEPARTUAES ON 25A CHANNED ASK TO 24K	RUNWAY 25L TUNNEL CONSTRUCTION (25CA COMPETE)	1978(YFR)	909	. 23	0,	2925	800	0	50	50 3849	4340	4340 1653	55121 6519	12/53
<u></u>	results		nt \$22 Run int \$224 Th int \$35 Run ing the tunn	Experiment #22 Runway 25R tunnel construction resulted in larger departure delays (about 56%), Experiment #22A The evailability of the dual taxions yetem during tunnel construction reduced the taxi delays, Experiment #35 Runway 25L tunnel construction after the completion of runway 25R resulted in less delay compared to the delays during the funnel construction on runway 25R (Experiment #22),	l construction of the dustruction on runway	tion resulted in larger departure delays (about 56%) and teatway system during tunnel construction reduce tion after the completion of runway 25R resulted in sy 25R (Experiment #22).	system he comp	rger dep during t letion o f22).	arture de unnel con f runvey	lays (ab atructio 25R resu	out 56%) n reduce	d the ta less del	xi delay	red to the	delays		
												ı					`, `;
	76/	1962 CHARGE		NOHE	1978(IFR)	5700	39	53	63 2714 164	164	کم		304 3208	8324	1578	556 15470	15476
	13 1962	7	DEPAKTURES SENT FROM	RUNINAY ZSA TUNNEL CONSTRUCTION	1978 (SFR)	4776 131	13,	17	17 5292 331	33/	7	4318	9948	4318 9948 7353 1757	1757	1/343 20452	2045

Experiment #23-- Runway 25% tunnel construction resulted in larger departure delays during IFR weather. Experiment #36-- Runway 25% tunnel construction, after the completion of runway 25% resulted in higher arrival delays (due to the demand for the use of runway 25%) than Experiment #23. 1318 | 9946 | 7353 | 1757 1527 9319 3339 1 9153 7 0 17 | 5292 | 331 440 5375 4 ø 6297 1978(IFR) TUNNEL LONSTRUCTION CONSTAUCTION 3ENT FROM 252 To 24L CLFHRTUNES SENT FRON 25R TO 2+L 36 1932 RESULTS:

21873

11028

- Modified Demand

-> = REVISION A, 7/18/80

TABLE 26 (CONTINUED)

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVILIES WITH 1982 DO-NOTHING CASE

_	_	
15 54	35 95	3.7 SENT FROM CONSTRUCTION 1978 LTFR) 6535 95 15 5493 328 11 3572 9454 9719 1696 11664
ir departure istruction (ulted in large d that the con ter the comple	RESULTS: Experiment #24 Runway 25L tunnel construction resulted in larger departure delays during IFR weather. (Experiment #24 compared to Experiment #23 indicated that the construction of runway 25L produced larger delays than the initial construction of runway 25R.) Experiment #37 Runway 25R tunnel construction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for the use of runway 25R)

>= REVISION A, 7/18/80

TABLE 27

IMPROVEHENT COMPARISONS

_			.
	TOTAL	11296	11242
TRAVEL TIPES (minutes)	DEPARTURES GROUND	5659	3331 3914 1623 5705 11242
VEL TIMES	CROUND C	L	279/
. TR	RRIV	4027	3914
TOTAL	CROUND A	3336	3331
•	CATE	30	27
IY (minut	JIWAY TAXI RUNWAY GA	8	6
URE DEL	TAXI	562	56/
DEPART	RUNMAY	634 57 81 2598 562	48 59 2626 581
((minutes)	RUNWAY X-ING	81	53
DELAY (TAXI	57	48
ARRIVAL DELAY	RUMMAY TAXI	634	2/6
AIR TRAFFIC	SEPARATIONS	1978 (VFR)	1982 (VFR)
EXP. DEMAND ARRIVAL DEPARTURES INPROVENENTS AIR TRAFFIC		NONE	DUAL
DEPARTURES	DEMAND REROUTED HODIFIED	i	1
ARRIVAL	DEHAND HODIFIED	1	1
DEMAND		7 1982	18 1162
a. ;		7	e 0

RESULTS: The dual taxivay system and the 1982 separations resulted in reduced arrival delays. No change was noted in the taxi delays.

١ ـ ١		1
10257	00/0/	
5349	1084	
1625	1201	
3786	3797	
2911	3106	
31	و	
0/	8	
485	494	
777	2048	
09	87	
48	28	
382	405	
1982(VFR)	1982(VFR)	
DUAL TAXIWAY	NEAA TERM	
DEPORTURES SENT FROM 254 PL 24K	"	
1	1	
1882	1982	
80	_	
	DUAL MAZ(VFR) 382	- SENT FROM THINMAY MAZ(VFR) 382 48 60 2277 485 10 31 2911 3726 - " TERM MOZ(VFR) 405 58 87 2048 494 8 6 3106 3797

RESULTS: The MEAR-TERM improvements resulted in reduced departure delays.

													•				_
10742	5304 10742	1611	3828	3026 3828	77	8	895	88 2360 468	88	٥	436	182(VFR)	BY-FASS TO RUNWAY 34A HOLDING MEA	1		1982	2
11242	3914 1623 5705 11242	/623	78E	333/	77	. 6	195	59 2626 561	59	48	2/15	1982(VFR)	DUAL	1	1	1962	8/
,																	

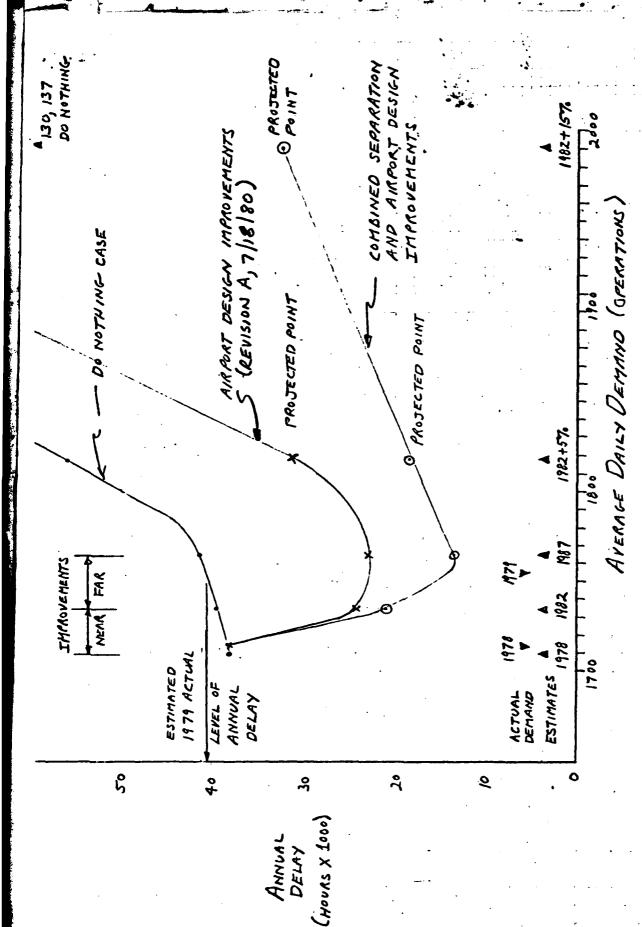
RESULTS: The by-pass to runway 24R and the holding area on taxiway 75 resulted in reduced departure delays.

TABLE 31

SUMMARY OF ANNUAL DELAYS (ESTIMATES)

DEMAND	ATC SYSTEM SCENARIO	IMPROVEMENTS	ANNUAL DELAY (HOURS)
1978	1978	none	37,991
1982	1978	none	39,630
1982 + 5%	1978	none	56,289
1982 +15%	1978	none	130,137
1982	1982	none	33,953
~1982	1978	1982	24,113 4- we 33150
1982	1982	1982	21,036
1987	1978	none	41,339
1987	1978	1987	22,908 4-war 71,188
1987	1987	none	24,354 13,496+ 21,728 (007A) PALLE EQ
1987	1987	1987	13,496

← = REVISION A, 7/18/80



SUMMARY OF ANNUAL DELAY ESTIMATES FIGURE 15

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

DATE:

NATIONAL AVIATION FACILITIES EXPERIMENTAL CENTER

ATLANTIC CITY, NEW JERSEY 08405

IN REPLY REFER TO:

SUBJECT:

Los Angeles Simulation Model Results

FROM: Program Manager, ACT-220

to: Frank Jones, AWE-530

Enclosed is Data Package No. 10 for review by the Task Force members. Data package No. 9 was presented at the last meeting of the Task Force on April 29, 1980.

Attachment A contains the results of experiments #35, 36 and 37 requested by the Task Force to study delays after construction is completed on either runway 25R (VFR and IFR weather) or runway 25L (IFR weather).

Attachment B includes a comparison of the traffic counts for the first Friday in August of 1978 and 1979

Attachment C includes comparisons and analyses of various experiments. The purpose of this attachment is to provide a narrative summary of those results for use by the Los Angeles Task Force in preparing their final report.

JOHN VANDERVEER

Accession For	4
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ATTACHMENT A RESULTS OF EXPERIMENTS #35, #36 and #37 (TUNNEL CONSTRUCTION)

TABLE 1
SET 8 DEMAND

	ERI-	RWY	RWY	RWY	RWY	TOTAL
ME	NI	24R	24L	25R	25L	
	A	95	72	0	196	363
22	D	29	162 '	0	235	426
(22A	TOTAL	124	234	0	431	789
	A	121	17	225	. 0	363
35	D	25	117	284	0	426
	TOTAL	146	134	509	0	789
	A	167	0	0	196	363
23	D	0	191	0	235	426
	TOTAL	167	191	0	431	789
	A	138	0	225	0	363
36	D	0	142	284	0 .	426
	TOTAL	138	142	509	0	789
	A	174	0	189	0	363
24	D	0	185	241	0	426
	TOTAL	174	185	430	0	789
	A	138	0	0	225	363
37	α.	0	142	0	284	426
	TOTAL	138	142	0	509	789
	A					
	D					
	TOTAL					

^{*} MODIFIED DEMAND

LAX - STAGE 2

EXPERIMENT NO. 35

OBJECTIVE:

To access the impact on aircraft delay in 1982 under VFR1 weather conditions due to the closure of 25L during construction of the Sepulveda Tunnel. Tunnel construction on 25R was complete and 1978 aircraft separations were utilized.

ARRIVAL RUNWAYS

DEPARTURE RUNWAYS

24L, 24R, 25R

And the second of the second o

24L, 24R, 25R

RELATED COMPARISON EXPERIMENTS:

Experiment #22 with tunnel construction on 25R and no improvement on 25L.

REMAINING DATA ITEMS:

1978 VFR1 separations were used. The 1982 demand was achieved by modifying the arrival demand for experiment #11 (moving 50 arrivals on the south complex to runway 24R) and changing all arrivals and departures on 25L to 25R.

TABLE 2

CLASS AND RUNWAY DEMAND DISTRIBUTION FOR ARRIVALS AND DEPARTURES

EXPERIMENT NO. 35

runway Name	24R	24L	25R	25L	TOTAL
		ARRIVAL	3		
CLASS 1 (HEAVY)	30	6	32	0	68
CLASS 2 (LARGE)	55	2	147	0	204
CLASS 3 (SMALL)	31	8	28	0	67
CLASS A (SMALLER)	5	1	18	0	24
TOTAL	121.	17	225	0	363

		DEPARTU	RES		
CLASS 1 (HEAVY)	0	53	44	0	97
CLASS 2 (LARGE)	8	51	174	0	233
CLASS 3 (SMALL)	-13	10	54	0	. 77
CLASS 4 (SMALLER)	. 4	3	12	0	19
TOTAL	25	117	284	0	426

ARRIVAL AND			,		
DEPARTURE TOTALS	· 146	134	509	0	789

	HES	GATE TO	ROLL	6.74	3.15	15.89	3.82	0.11	7.88	21.99	4.43														
	VEL TI	SH GA	GATE	25							4.51 1	-	OTAL	DELAYS	DEP	DELAY	1.7	7.4	10.0	8.0	4.6	12.0	16.3	8 13	
!4	GE TRAVE	THRE										f	GRAND TOTAL	ERAGE	K.R.	LAY	2.0	2.0	3.9	2,5	2.7	را را	2.0	2.1	}
COMPLET	AVERA	FIX TO	THRESH TO	10.91	11.58	13,37	11.09	12.46	14.19	10.67	11.56	1	ت ا	₹						_	~	_	٠.	e	
25r Tunnel Complete		DIF		7.0	7.7	٥.	. S.	5.9	3.6	0.5	6.3					DNC 10				, n	. 0 4.	Ç.		1.8	Ī
			<u> </u>									į			-	s our					0				
CLOSED											41.0	ŧ				CRS									ŧ
25L C		TOT		41.0	56.3	59.9	49.5	49.1	56.4	60.0	47.3	F			TOT		1.5	6	7.5	9	4.1	6.7	11.0	9	Ï
	S	RWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	†		رئ	ΚWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	‡
RTE=X1	TURE	RWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ŧ		DEPARTURES	Ŕ₩Y		0.0	0.0	0.0	0.0	0:0	0.0	0.0	0.0	ŧ
X35	DEFAR	RWΥ	251.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	ļ		DEPAR	КWY	25L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
SCHED=X35		RWY	25R	25.7	28.2	21.3	22.6	36.8	27.5	20.9	0 24.6 0.0 0.0 0.	ļ	!		FWY	25R	2	7.3	8.2	13	e Ci	6.9	7.2	6.1	
4		RWY	24L	3.0	3.8	2.4	1,8	6.0	1,6	1,1	7.0	ł	1		RWΥ	24L	C.	3.8	6.4	€.	1.8	5,3	8.9	1.4	1
CONFIG=A SW RATES						16.2 2						 	DEL AYS		ΚWY	24R	0.0	7.7	8.6	5.0	4.7	17.4	18.2	6.4	1
ű		DIF		-1.0	1.0	es f	1.2	-3,3	3.6	Ci i	۲.	1	AVERAGE I		TAXI	ΝI	-:	Ġ		Ġ	٠.	₹.	'n	٥.	4
SEP=78VFR1 AVERAGE F		-31	MAND	27.0	4.0	0.0	0.0	0.09	5.0	0.68	53.0	4	₹ •		RWY.	CRS	0.0	•	•	Ξ.	•	•	•	0	4
		TOT									53.7	ŀ	•		T01		7.9	1.9	3.8	5	5	5.1	1.7	2.0	ł
DEMAND=82		RWY									0.0	1			КWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4
끮	OLS.	RWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		•	ALS	ΕWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
ន	ARRIV	RWY	25L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0)	ARRIV	KWY	25L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	
LAX EXP' 35											31.8	١												5.7	1
LA											0	- 1			ΚWY	24L	0.0	4,	•	4	8.	•	0.0	Ņ	
											15.9	ł				248			•	٥.	υŢ	6.5			
		TIME									1400-1500	1			TIME		700- 800	006 -00B	900-1009	1000-1100	1100-1200	1000-1300	002T-005T	1460 -1500	

clean-up hour

LAX - STAGE 2

EXPERIMENT NO. 36

OBJECTIVE:

To access the impact on aircraft delay in 1982 under IFR1 weather conditions due to the closure of 25L during construction of the Sepulveda Tunnel. Tunnel construction on 25R was complete and 1978 aircraft separations were utilized.

ARRIVAL RUNWAYS

DEPARTURE RUNWAYS

24R, 25R

24L, 25R

RELATED COMPARISON EXPERIMENTS:

Experiment #23 with tunnel construction on 25R and no improvement on 25L.

REMAINING DATA ITEMS:

1978 IFR1 separations were used. The 1982 demand was achieved by changing the schedule used in experiment #12M (modified) - the arrivals on 25L were moved to 25R.

TABLE 4

CLASS AND RUNWAY DEMAND DISTRIBUTION FOR ARRIVALS AND DEPARTURES

EXPERIMENT NO. 36

runway Rame	24R	24L	25R	25L	TOTAL
		ARRIVALS			
CLASS 1 (HEAVY)	36	0 .	32	0	68
CLASS 2 (LARGE)	57	0	147	0	204
CLASS_3 (SMALL)	39	0	28	0	67
CLASS 4 (SMALLER)	6	0	18	0	24
TOTAL	138	0	225	0	363

		DEPARTURES									
CLASS 1 (HEAVY)	0	53	44	0	97						
CLASS 2 (LARGE)	0	59	174	0	233						
CLASS_3	. 0	23	54	0	77						
CLASS 4 (SMALLER)	0	7	12	0	19						
TOTAL	0	142	284	. 0	426						

		···			
ARRIVAL AND DEPARTURE TOTALS	⁻ 138	142	509	0	789

TABLE 5

	EL TIMES	H GATE TO	E ROLL	8 8,39	9 20.29	9 26.50			4 26.10		8 42.77	20.43	TAL	ELAYS	DEF	DELAY	3.1	14.1	20.8	31.1	28.0	20.1	28.1	37.1	<u>[</u>
MPLETE	AVERAGE TRAVEL	X TO THRESH	THRESH TO GATE				22.67 4.74					1:18	GRANE TO	AVERAGE D	ARR	DELAY DEL	3.8	4.2	8.8	13.1	22.5	35.1	33.9	26.0	32.3
25R TUNNEL COMPLETE	Œ	<u>. </u>	Ξ									0				CNG	0.0	1.4	0.9			ы. В.	10.9		7.42
		DIF			-18.6				ŧ		4.4	6			TAXI		נים		•	_	1.3		9.	8.	F
CLOSED		DE-					48.0					5			RWY							0.0			-
25L C		TOT					50.6					2			TOT							15.9			7.27
	ES	RWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9		ES	ŔWΥ		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	•
	ARTUR	FWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	7 0.0 0.0 0	9.		ARTUR	₹WY	•	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	•
SCHED=X36	DEP	RWY	25L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	P		DEP	ñWΥ	25L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	‡
SCHEI		RWY	258	20.7	18.4	19.1	15.2	17.3	18.3	16.7	16.7	þ				_	_	_	_					10.7	1
6=A ES		RWY	24°	18.6	27.0	36.0	34.4	34.0	28.9	28.9	28.7	•			RWY	24	9.	12,3	15.6	18,4	15.9	18.3	20.0	18.6	‡ ‡
CONFIG=A W RATES		ŔΨY	248	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	þ	DELAYS		КWY	24R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	•
SEP=78IFR1 CONFIG=6 AVERAGE FLOW RATES		DIF		-1.1	κĵ	-5.9	-9.8	-12,5	-1.9	4 U	-10.4	1	AVERAGE D		TAXI	Z.	٠.	Ņ	Ġ	Ġ	'n	٤.	Ġ	ĸ	
SEP=7 AVER		- 31	MONE	27.0	44.0	40.0	55.0				53.0	þ	ð		Ŕ₩Y	CRS	•	•	•		•	•	°.	o.	ŧ
83		TOT		25.9			45.2				42.6				TOT		3.6	3.9	8.6	12.8	22,1	34.7	33.7	25.6	100
DEMAND=		ŔΨ									0.0	₽ ₽			ΚWY		0.0	0:0	0.0	0.0	0.0	0.0	0.0	0.0	•
ā	VALS	ΚWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0 0.0	ļ		VALS	ΚWY		0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	†
38	AKKI	ñΨΥ	25L	0.0	0.0	္ .	0.0	0.0	0.0	0.0	0.0	ŧ		AKKI	RUΥ	25L	0.0	0.0	0.0	0.0	0.0	0.0	0:0	0.0 0.0	•
LAX EXP		ŔWΥ	258	21.9	24.5	25.1	26.2	0.98	22.1	6.55	23,3	+		•	RWΥ	25R	4.3	4.7	11.3	19.9	28.2	16.2	14.0	43.1	+
נג											0.0													0.0	1
		RWY	2.15	9.6	30.0	8.0	19.0	ر ا	21.0	19.6	19.3	+			ñΨΥ	24R	0.0	3.0	9.	3.1	14.8	23.6	21.4	4.1	44
		TIME		200- 800	800- 900	0001-006	1000-1100	1100-1200	1200-1300	1300-1400	1400-1500	1000 TOOL 1			THE		700- 800	800- 900	6001-006	1000-1100	1100 - 1200	1200-1300	1300-1400	1400-1500	* 1500 1000

* clean-up hour

LAX - STAGE 2

EXPERIMENT NO. 37

OBJECTIVE:

To access the impact on aircraft delay in 1982 under IFR1 weather conditions due to the closure of 25R during construction of the Sepulveda Tunnel. Tunnel construction on 25L was complete and 1978 aircraft separations were utilized.

ARRIVAL RUNWAYS

DEPARTURE RUNWAYS

24R, 25L

24L, 25L

RELATED COMPARISON EXPERIMENTS:

Experiment #24 with tunnel construction on 25L and no improvement on 25R.

REMAINING DATA ITEMS:

1978 IFR1 separations were used. The 1982 demand was achieved by changing the schedule used in experiment #12M (modified) - the departures on 25R were moved to 25L.

TABLE 6

CLASS AND RUNWAY DEMAND DISTRIBUTION FOR ARRIVALS AND DEPARTURES

EXPERIMENT NO. 37

runway Name	24R	25L	TOTAL		
		ARRIVALS]
CLASS)	36	0	0	32	68
CLASS 2 (LARGE)	57	0	0	147	204
CLASS 3 (SMALL)	39	0	0	28	67
CLASS A (SMALLER)	6	0	0	18	24
TOTAL	138	0	0	225	363

		DEPARTUE	ES		
CLASS 1 (HEAVY)	0	53	0	44	97
CLASS 2 (LARGE)	0	59	0	174	233
CLASS 3 (SMALL)	. 0	23	0	54	97
CLASS 4 (SMALLER)	0	7	0	12	19
TOTAL	0	142	0	284	426

ARRIVAL AND DEPARTURE	138	142	0	509	789
TOTALS			<u> </u>		

ABLE 7

	S	10	Ļ	06	00	22	41	60	84	51	6.7	53											• •	•	
		GATE TO				56.	36.41	33.	28.	37.	43	58.	ا پر	AYS.	<u>بر</u>	LAY	2. 20	3.7	1.0	50.3	27.5	53.6	31.6	19.7	
	TRAVEL	HRESH	GATE	4.50	S.00	4.51	4.98	5.14	4.96	5.05	13. 53 80	A.58	D TOTA	GE DEL	_	当		7	e va	.~,	C4	t 4	ניה	נייו	•
TT.	ERAGE	1.07	ESH TO	12.14 4.50	.60	33	22.64	.98	.21	.49	.50	52	GRAND TOTAL	AVERA	ARR	DELAY	3.7	4.3	8.9	12.9	22.6	35,3	32.8	25.0	
ar core	A	FIX	THR	12	13	31	23	31	44	41	33	9			λM	SKG	0.0	0	٠, د،	0.	1.1	5.4	12.6	5	(
25L TUNNEL COMPLETE		DIF		-8.3	-19,8	1.2	1.7	0.0	-15,2	-6.4	8.8	ŀ			_	OUT	m.	.7	æ	H	1,2 12	••	=	8.2	3
		DE	JAND				48.0									CRS	•	•	0.	•	•	o.	•	•	•
CLOSED		TOT					49.7								TOT		ci ci	0.21	14.0	17.0	14.3	16.3	18.2	17.3	
1 25R	m	КWY		0			0.0							m	RWY		•	0	0	0	•	o.	0	0	<
RTE=X1	RTURE	KWY KWY K		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4		RTURES	RWY		0.0	0.0	0.0	0.0	0.0	0.0	14.0 0.0 0	0.0	
	DEPA	Ŕ₩Ÿ	251	20.7	19.2	18.9	15.5	19.3	18,7	16.7	17.9	9	•	DEPAI	RWY	251.	3.8	11.3	11.2	15,2	11.2	11.7	14.0	10.4	•
SCHEB=X37		ŔΨY	258				0.0					- 1			₹WY	25R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	•
		RWY	24L	19.0	25.0	57.3	34.2	32.7	31.1	30.9	29.9	9	· ·		RWY	24L	•	12,8	15.4	17.8	16.3	19.3	21.0	21.5	
CONFIG=A		RWY	24R	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	4	DELAYS										0.0		
ī		DIF		-1.1	ij	619-	2.6-	11.7	5.6	8.3	-7.0	100	AVERAGE I		TAXI	ZI	٠,	લ	ભ	۲.	4.	M.	ņ	ហ	•
SEP=781FR1 AVERAGE		<u>-</u>	IND				55.0						AVE			CRS	•	<u>.</u>	°.	۲.	•	•	•	0.	•
		TOT	Σ	5.9.2	14.55 4	53.1 4	45.8	18.3 6	17.6 4	7.3 3	2 0.9	1)		TOT		3,6	4.0	8.7	2.8	2.5	14.9	32.5	4.4	
DEMAND=82		RWY		0.0	0.0	0.0	7 0.0	0.0	0.0	0.0	0.0	4	l !		КWY					0.0	0.0	0.0	0.0	0.0	
<u>G</u>	JALS	RWΥ		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4	•	APLS	КWY		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
37	AKKI	КWY	25L	6.12	24.5	1.5	.0 26.8 0.0	25.7	25.3	.; · 9	25.1	1	!	ARKI	FWY	72	4.5	4.7	2·11	19.5	27.8	44.5	40.B 0.0	40.9	
LAX EXP		RWY	258	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4			RUY	25R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
LA)		RWY	24L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		•		Ŕ₩Y	24L	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	
		RWY	348	4.0	20.0	⇔	19.0	21.6	22.3	21.1	30.9	+	;		RWY	24R	0.0	34.2	¢.	ei M	15.2	24.0	22.13	4.6	
		TIME					1000-1100					- 1			TIME								1300-1400		

clean-up hour

ATTACHMENT B

COMPARISON OF TRAFFIC COUNTS AND DEMAND

The traffic counts and projected demands over a 24-hour period are shown in Table 1. In addition, the 1978 and 1979 OAG schedules for the first Friday in August were obtained to determine the changes in scheduled activity.

In 1979, airlines who scheduled OAG flights in 1978 increased their activity by 3.3%. There were 1323 scheduled flights in the 1978 OAG and 1366 scheduled by the same airlines in the 1979 OAG.

The actual activity level for 1979 showed an increase of 2.2% for the 24-hour traffic count over the same period of time in 1978 (1717 aircraft in 1978 and 1755 aircraft in 1979). The projected 1982 demand represents a 1.5% increase over the 1978 24-hour base demand (1735 aircraft in 1982 and 1710 aircraft in 1978). The 1982 demand was increased by 5% and 15% resulting in an increase of 6.3% and 16.4% over the 1978 24-hour base demand. The 1987 demand represents 3.2% increase over the 1978 24-hour base demand (1764 aircraft in 1987 and 1710 aircraft in 1978).

The 1982 demand for the 24-hour period is 1.2% less than the actual 1979 traffic count (1735 aircraft in 1982 and 1755 aircraft in 1979). The actual 1979 traffic count is less than the 1982 +5% level of activity and the projected 1987 demand. The fleet mix percentages for the 1979 OAG schedule and the projected 1982 OAG schedule are as follows:

	<u>1979</u>	<u>1982</u>
Heavy-Class 1	24.7%	28.9%
Large-Class 2	56.5%	59.4%
Small-Class 3	16.4%	11.7%
Smaller-Class 4	2.4%	0.0%

Comparisons indicated that the 1979 demand on the Los Angeles International Airport increased to a level slightly above the projected 1982 demand, but the projected 1982 conversion of the fleet to the larger aircraft has not occurred in the 1979 demand.

TRAFFIC COUNT FOR FIRST FRIDAY IN AUGUST

O.		Increase 1978 Demand
1987 DEMAND 43 43 23 23	113 147 113 113 113 114 115 92 92 94 95 108 85 85 86 108 87 116 116 116 116 116 116 116 116 116 11	3.2% Over Base
1982 DEMAND +15Z 52 47 26	18 23 40 84 125 108 116 116 117 119 119 119 119 119 119 119	16.4% Increase Over 1978 Base Demand
1982 DEMAND +5Z 47 43 24 8	116 117 117 100 117 117 110 88 88 110 84 84 84 84 116 116	6.3% Increase Over 1978 Base Demand
1982 DEMAND 45 41 23	16 19 34 73 109 94 94 94 95 105 83 83 80 80 69 69	1.5% Increase over 1978 Base Demand
1979 TRAFFIC COUNT 43 42 20	114 115 116 1114 1114 1107 98 98 98 101 101 1755	2.2% Increase Over 1978 Actual Traffiq Count
1978 DEMAND 43 37 23	17 17 103 92 98 111 110 93 86 86 86 88 95 108 108 1710	BASE
1978 TRAFFIC COUNT 37 42 24	114 14 34 69 105 101 118 108 108 108 108 83 83 80 1717	ACTUAL
0000 0100 0200	0,000 0 0,000 0,000 0,000 0,000 0,000 0,000 0,000 0,000 0,000 0 0,000 0	

ATTACHMENT C

NARRATIVE SUMMARY OF RESULTS

(INFORMATION FOR THE TASK FORCE FOR PREPARATION OF FINAL REPORT)

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 - 2.2.2. Airport Design Improvements2.2.3. Air Traffic Demand
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- 2.4. Comparison of Experimental Results
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- 3. SUMMARY OF RESULTS
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1. INTRODUCTION

1.1. General.

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Airfield operations at the Los Angeles International Airport are expected to increase in the immediate future. A study of the effects of this increase in air traffic demand and proposed improvements at the airport (procedures, hardware, and airport design) was initiated in June 1975. The results of the initial capacity study appeared in an Interim Report (September 1977) issued by the Los Angeles International Airport Improvement Program Task Force. The present delay study was based upon the report and a technical plan prepared in September 1978, along with a Federal Aviation Administration report (FAA-EM-78-8A) entitled "Parameters of Future ATC Systems Relating to Airport Capacity/Delay" (June 1978).

1.2. Objective. The purpose of this effort was:

- To identify the causes of delay and determine the effect of various airport design improvements on delay at the airport.
- To identify the delay reduction benefits of alternative procedures and the hardware improvement options for immediate, short term and long term implementation.
- 3. To determine the relationships between air traffic demand and delay in the present and future time periods as an aid to establishing acceptable air traffic movement levels.
- 4. To obtain new insight into the interdependence of terminal facilities, airport design, procedures, fleet mix and air traffic demand.

1.3. Background.

The airport delay study began with a description of the present day air traffic control procedures at the Los Angeles International Airport. A report was prepared in July 1978 (FAA-NA-96-156-1) which revised and updated the ground/airborne scenarios. The next step was the preparation of a technical plan which included a list of the experiments to be performed and information regarding the application of the airfield simulation model. Various steps and milestones were planned along with a description of data requirements for the computer (model) runs.

The effort was accomplished by the Airport Improvement Task Force reviewing a series of data packages containing information on the preparation of the model runs, revisions to the experimental design (suggested by the Task Force) and the results of the experiments. The data packages contained infomation on the calibration of the model based on field data, description of the model inputs for the experiments, air traffic demand forecasts (including runway and aircraft class distributions), results of experiments and preliminary analysis of those results.

Comments on each of the data packages by the Task Force were incorporated into subsequent work performed on the program.

2. DISCUSSION.

2.1. Air Traffic Control Procedures.

The air traffic control service at the Los Angeles International Airport is extended to each airline company, general aviation, the military, the airport authority, the local and regional residents, and the general public. The ATC procedures employed at the airport are responsive to a variety of geographic and airfield conditions. The desired result is a safe level of service which holds delays to minimum throughout the day by applying present day air traffic control rules and regulations.

Some specific service conditions reflected in the ATC procedures are:

- The assignment, when possible, of arrivals to runways closest to their gate areas.
- The assignment of departures to runways based on the route of flight (with the exception of heavy aircraft which must use the north complex).
- Restricted use of departure runway 24R as a noise abatement procedure.
- 4. Over ocean nighttime operations.
- 5. Greater utilization of south complex.

The ATC procedures are considered in the study in two ways. The separations maintained between arrivals and departures are used as model inputs for the computer run. The present day conditions at the airfield are reflected in the gate and runway distributions used for experiments with VFR conditions and no airport design improvements.

2.2. Experimental Design and Model Application.

The experimental design for this effort was developed early in the program and is shown in Table 1. The experiments were divided into two stages to permit a review of some initial results and changes in the remaining experiments to take advantage of any redirection of effort indicated by those findings. The three main areas of the experiments which had to be translated into model inputs were the air traffic control scenario, the airport design improvements and the air traffic demand.

2.2.1. Air Traffic Control Scenarios.

The time frame for the air traffic control scenario indicated the aircraft separation values to be used for the experiment for either VFR or IFR weather conditions. Present day VFR separation values were established by calibrating the model (i.e., matching model output to field data collected at the facility). The base values for arrival-to-arrival and departure-to-departure separations were obtained from the FAA report on "Parameter of Future ATC Systems Relating to Airport Capacity/Delay" (FAA-EM-78-8A). The remaining values for separations followed the results obtained through calibration. Specific nighttime separations had to be developed from information provided by the facility. The referenced separations did not apply to a runway dependency with arrivals opposing the flow of the departures.

2.2.2. Airport Design Improvements.

The airport design improvements were initially identified in the Los Angeles International Airport Improvement Task Force Interim Report. The near term improvements were noted in Table 1, Los Angeles Delay Experiments.

The near term improvements included:

- High-speed taxiway off runway 25L to the south (Improvement #2).
- 2. Strengthening of the Sepulveda Tunnel (Improvement #3).
- 3. New taxiway access to the threshold of runway 24R.
- 4. Temporary holding areas for future taxiway 75.
- 5. Parking for 20 aircraft at the west end of the airport.
- Terminal Expansion including Satellite 1 and the International Terminal.
- 7. High-speed taxi exit off runway 7L (Improvement #5).
- 8. High-speed exit off runway 6R to taxiway 47 (Improvement #7).
- 9. Departure by-pass around 7L to 7R (Improvement #8).
- Opening runway 25 for small aircraft arrivals and departures during tunnel construction.

Various near term improvements were introduced into different experiments to determine their effectiveness in reducing delays and process ing the air traffic demand. The improvements were introduced into the experiments by changing the model inputs and the runway demand distributions.

The changes in the model inputs can be illustrated by comparing a link-node diagram of the airport used to develop model inputs for the present day setup, Figure 1, with the diagram showing the noted improvements, Figure 2. Some of the improvements necessitated changes in the distribution of the air traffic demand to the runways and gates. For example, strengthening of the Sepulveda Tunnel permitted heavy departures from the south complex and generated a greater demand on runways 25R and 25L because of their proximity to the gate areas 4, 5, 6, 7 and 8.

LOS ANGELES DELAY EXPERIMENTS

Near Tearm; improvements		None	None	None	None	None	None	None	None	None	None	None	1982	1982	2, 3,	5,78	5, 7, 88	None	Tunnel Construction	Tunnel Construction	Comments-Usage for Light	
ATC System scenario		1978	1978	1978	1978	1978	1978	1982 (+54) (+154)978	1982 (+54) (+154)1978	1978	1978	. 1978	1982	1982	1982	1982	1982	1978	1982	1982	1982	
Demand		1978	1978	1978	1978	1978	1978	1982 (+54)	1982 (+54)	1982	1982	1982	1982	1982	1982	1982	1982	1978	1982	1982	1982	
Weather	•	VFRI	IFRI	IFR2	VFRI	IFRI	VFRI	VFR1	IFRI	VFRI	VFRI	IFRI	VFR1	IFRI	VFRI	VFRI	VFRI	n. 4	VFRI	VFRI	VFRI	
Departure		24L, 24R, 25L, 25R	24L, 25R	24L, 25R	24L, 25R	24L, 25R	6L, 6R, 7L, 7R	24L, 24R, 25L, 25R	24L, 25R	6L, 6R, 7L, 7R	24L, 25R	24L, 25R	24L, 24R, 25L, 25R	24L, 25R	24L, 24R, 25L, 25R	24L, 25R	6L, 6R, 7L, 7R		24L, 24R, 25L			
Arrival		24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	24R, 25L	6R, 7L	6R, 7L	6L, 6R, 7L, 7R	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	6L, 6R, 7L, 7R	6R, 7L	6R, 7L	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	6R, 7L	6L, 6R, 7L, 7R	n.a.	24L, 24R, 25L	24L, 24R, 25L, 25xK	24L, 24R, 25L, 26	
Study			7	€	'n	9	4	-	7	4	rs	9	~	2	_	ĸ	. •	n. a.		7	7	
Model	u	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ADM	RCM	RCM	RCM	plicable.
Experiment number	Stage 1 Experiments	-	7	· en	•	ĸ	. 🕶	7 (7A) (7B)	(80) (48)	6	01	Y01	11	12	13	15	91	11	17 A	17 B	17 C	n.a. = not applicable,

Study cases (combinations of runway use and weather conditions) are defined in Figure III-1.

FAA will describe impact of 1982 and post-1987 ATC systems on model inputs.

Potential near-term improvements are identified in the Los Angeles International Airport Improvement Task Force Interim Report, and in 4 & j

Airfield Simulation Model. Appendix B. ÷ ;

Task Force establishes packages of near-term improvements most likely to be implemented in 1982 and 1987 time frames. The 1982 package includes improvement # 3 (strengthening of the Sepulveda Tunnel), (cont.)

TABLE 1 (CONTINUED)

LOS ANGELES DELAY EXPERIMENTS

- (cont.) new taxiway access to threshold of Runway 24R, and temporary holding areas on future Taxiway 75. The 1987 package includes all 1982 improvements plus Satellite 1, International Terminal, and/or remote parking for 20 aircraft at west end of airport. These packages of improvements are subject to Task Force review and revision.

 - Impact of absence of Improvements # 2 and #3 (high-speed taxiway of Runway 25L and strengthening of the Sepulveda Tunnel).
 Improvement # 5 is a high-speed taxi exit off Runway 7. Improvement # 7 is a high-speed taxi exit to Taxiway 47 from Runway 6R.
 Improvement #6 is a bypass area on the north side of Runway 7L. <u>ن</u>ا ن
 - Annual Delay Model. ė
- Runway Capacity Model. Runway 25R closed for tunnel construction.
- During closure of 25R for tunnel construction, parts of Runway 25 are open for small aircraft arrivals and departures.

14 A

TABLE 1 (CONTINUED)

LOS ANGELES DELAY EXPERIMENTS

Near-term improvements		101	Terminal Expansion	Terminal Expansion	Remote Terminal	Tunnel Construction	Dual TaxiwayP	Tunnel Construction 25R	Tunnel Construction 25L	1987	1987	1967	1962	None	1982	None	1987	None	1987	None	Tummel Construction 25L. 258 Dome	Construction 25L, 25R	Coastruction
ATC System scenario		1982	1978	1982	1982	1978	1978	1978	1978	1981	1987	1987	1982	1982	1978:	1978	1987	1987	1978	1978	1978	1978	1978
Demand		1982	1982	1982	1982	1982	1982	1982	1982	1987	1987	1987	1982	1982	1982	1982	1987	1987	1987	1987	1982	1982	1982
Weather		R VFR1	R VFR1	R VFRI	R VFRI	VFR1	VFR1	IFRI	IFRI		SR VFR1:	IFR1	B. B.	n. a,	n. a.	n, a,	л. а.	n. 2.	n. a.	n. a.	VFR1	INI	1241
Departure Runways		24L, 24R, 25L, 25R	24L, 24R, 25L	24L, 24R, 25L	24L, 25L	24L, 25R	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	24L, 24R	n.a.	л. а.	n, a.	n.a.	n.a.	ъ. в.	n. a.	n.a.	24L, 24R, 25R	24L, 25R	24L, 25L			
Arrival Runways		24L, 24R, 25L, 25R	24L, 24R, 25L	24L, 24R, 25L	24R, 25L	24R, 25R	24L, 24R, 25L, 25R	24L, 24R, 25L, 25R	51,	D. B.	n. a.	n.a.	n.a.	n. a.	p. 2.	D. D.	n.a.	241, 24E, 25E	24E, 25E	24R, 25L			
Study		-	-	-	-	7	∞	60	•	-	-	~	•	n. 2.	n. a.	n. a.	n. 2.	n. 2.	n. a.	n. 2.	.		
Model		ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASM	ASH	E	ADM	A.514	¥	19						
Experiment number Stage 2	Experiments	92	19 A	70	17	22	22A	23	54	52	5 2	5	7	87	67	30	31	32	33	*	×	*	

Imprevenent #10 consists of a series of taxiway improvements identified in Appendix B.
Construction of Satellite I and International Terminal. The need for this experiment will be reviewed by the Task Force after consideration of future airline terminal locations.

Remote parking for 20 aircraft at west end of Airport. Additional experiment may be needed to test value of dual taxiway system around Satellite 4 during tunnel constructionl

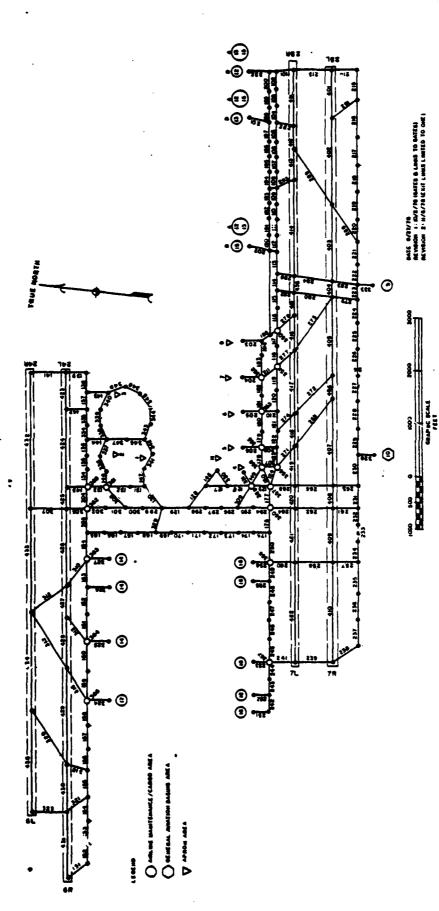
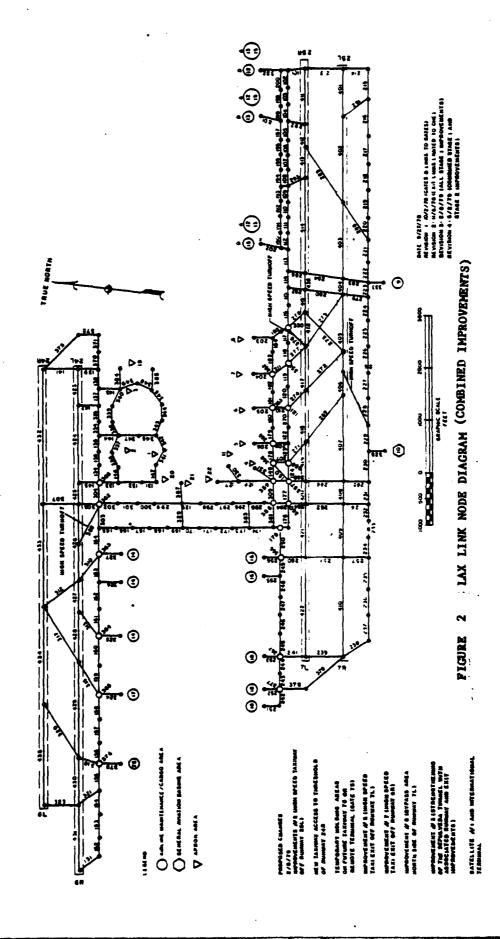


FIGURE 1 LAX LINK NODE DIAGRAM (PRESENT)



2.2.3. Air Traffic Demand.

Actual and forecasted air traffic demands were prepared for the 1978, 1982 and 1987 time periods. Additional 1982 aircraft schedules were prepared in total daily increases of 5% and 15% over the projected 1982 operations.

Another air traffic demand schedule was constructed for the 1987 time period which added a 10% increase in arrivals and departures during peak hours.

The hourly air traffic demands are shown in Tables 2 through 7.

Each air traffic demand applied to an experiment required a specified arrival and departure runway distribution and individual gate assignments by airline.

The basis for the initial VFR distribution of traffic was the field data collected at the airport during the week of September 24, 1978. Data reduction programs calculated the actual distribution of traffic over the runways and gates.

When the experiment required another weather condition or an improvement in airport design, the aircraft schedule was changed to reflect the proper weather condition or the revised airport operation. After the computer simulation of a particular experiment, the delay and travel time summaries were analyzed to determine whether the results represented logical operating conditions for the airport. If necessary, the demand was modified to produce a reasonable distribution of traffic on the runways by reassigning arrivals from the south complex to the north complex of the airport. This was done by changing the runway assignments in the schedule and/or dynamically reassigning runways during the model run.

As an example, the original demand for experiment #2 was modified by reassigning arrivals and is referred to as demand schedule #2M. For experiment #11 (rerouted), the original demand schedule for experiment #11 wad dynamically modified by changing one of the model's input parameters. When delays for departures on runway 25R began to build to a high level, departures assigned to runway 25R on the south complex were rerouted to runway 24R on the north complex.

Changes in the demand, whether by schedule changes and/or dynamic rerouting, produced lower delay values and better traffic flow over the entire airport.

The actual (1978) and projected (1982, etc.) demand schedules were used to calculate the estimated annual demand and passenger enplanements for the Los Angeles International Airport. The basic assumption in the calcualtion was that the demand represented an average day over a 2 month period, July and August, which comprised about 19% of the total traffic and 25% of the passenger enplanements. The calculations are shown in Table 8.

TABLE 2
1978 DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI	AIR TAXI	GENERAL AVIATION	TOTAL
	i i	AND			
		AIR CARRIER			
		ARRIVALS			
0000	16	0		2	19
0100	10	7	0)	12
0200	6	7		0	
0300	<u> </u>				
0400	_ <	<u> </u>	<u> </u>		10
0500	4		<u></u>	9	
0600	9	<u>-</u>		4	76
0700 0800	16			<u> </u>	29
0900	23	3			39 40
1000	35				50
1100	41	4	6	B	59
1200	31_	7	- 3	9	45
1300	29	0	3	10	42
1400	29	4	3	10	47
1500	26		3	11	43
1600 to					
2400	269	10	32	52	363
TOTALS	575	52	83	136	846
		DEPARTURES			
0000	19		2	2	24
0100	9	10	0		19
0200		7			9
0300		2			4
0400					7
0500	4		<u> </u>		
0600	9	2 1	4		17
				2	
0700	32	4		6	48
0800	49	3	3	9	4R 64
0800 0900	38	3 4		6	48 64 52
0800 0900 1000	49 38 34	2		6	48 64 52 48
0800 0900 1000 1100	38	4 3 4 2 3		\$ \$ \$	98 64 52 48 53
0800 0900 1000 1100 1200	49 38 34 34 44	2		\$ \$ \$ 	98 64 52 98 52 53
0800 0900 1000 1100 1200 1300	49 38 34 34 44 39	3 3		\$ \$ \$!!	98 64 52 98 52 65 51
0800 0900 1000 1100 1200 1300 1400	49 38 34 34 44 39 20	3 3 5		\$ \$ \$ 	98 64 52 48 52 65 51 31
0800 0900 1000 1100 1200 1300 1400	49 38 34 34 44 39 20 30	3 3 5 1	\$ \$ \$ \$ 7	K 9	98 64 52 48 52 65 51 31 33
0800 0900 1000 1100 1200 1300 1400	49 38 34 34 44 39 20	3 3 5		\$ \$ \$!!	98 64 52 48 52 65 51 31
0800 0900 1000 1100 1200 1300 1400 1500	49 38 34 34 44 39 20 30	3 3 5 1	\$ \$ \$ \$ 7	K 9	98 64 52 48 52 65 51 31 33
0800 0900 1000 1100 1200 1300 1400 1500 1600 to	49 38 34 34 44 39 20 30 214 578	3 3 5 1	3 5 7 7 6 32 84 TION (0000 E	6 9 5 6 11 10 12 7 44 126 0 2400)	9A 64 52 48 52 65 51 31 43

TABLE 3 1982 DEMAND

TIME	AIR CARRIER	SUPPLEMENTS	AIR TAXI	GENERAL	TOTAL
	į	OF AIR TAXI		AVIATION	
		AND		i i	
		AIR CARRIER			
		ARRIVALS			
- 0000	12	4		2	19
0100	14		0		22
0200	4	7	2	0	13
0300	3				4
0400	4				9
0500	5	3			
0600				4	16
0700	17				-35_
0800	27			 7	45
0900	26	<u>Z</u>	4	1	91
1000	38			<u> </u>	53
1100	43		7	<u> </u>	(2
1200 1300	30			7	44
1400	28			/6	40
1500	35	7		10	-53
1600 to	 - 				
2400	271	12	33	52	368
TOTALS	582	58	83	136	859
		DEPARTURES		-	
0000	22	0	1	2	26
0100	R	11	0	0	19
0200	4	5		0	10
0300		9		0	. 4
0400	4	2			
0500	1_1				10
0600	/6	2	4	2	18
0700	30				44
0800	49	3		9	64
0900	42				-54
1000	34				48
1100	34	3	4		52
1200	42				65
1300	9.3			10	54
1400	22		<u></u>	12	41
1500	30				43
1600 to 2400	213	24	32	44	313
ZGUU					
		36 1	P.A	. <i>136</i> '	B7 <i>E</i>
TOTALS	591	75 ASS DISTRIBUT	84	126	876

23.9 % 5.2 %

55.0 % 15.9 %

TABLE 4

1982 + 5% DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND	AIR TAXI	GENERAL AVIATION	TOTAL
	1	AIR CARRIER		į į	
		ARRIVALS			
0000	12	5	7	2	20
0100	14	8	٥		23
0200	4	B	2	0	14
0300	3	1	٥		4
0400	4			0	9
0500		3			9
0600	6			4	
0700	17			_5	26
0800	27		 -	7	47
0900	26	4		7	43
1000	38	3		- 2	<u>56</u>
1200	43				46
1300	30	3	7	10	42
1400	35	3	4	10	55
1500	19	3		11	38
1600 to					
2400	271	30	33	52	386
TOTALS	582	99	83	136	900
		DEPARTURES			
0000	22		2	1 2	27
0100	2	12	0		20
0200	4	5			
0300	0	3			4
0400	4	2			
0500	4		0		10
0600	10		<u> </u>		
0700	39	8			<u> </u>
0800	77			7	67
0900	42	<u> </u>	<u> </u>	-5	57
1000 1100	34	7		-	50
1200	34	10		- //	55
1300	43	3			57
1400	22	2		12	43
1500	30	2		7	45
1600 to				 	
2400	213	40	32	44	329
TOTALS	591	117	84	126	9/8
·		ASS DISTRIBU	TION (0000 +	0 2400)	
	O1	FRIVIDA	/	/	
	Class 1	Class 2	Class 3	Class 4	

TABLE 5
1982 + 15% DEMAND

TIME	AIR CARRIER	SUPPLEMENTS	AIR TAXI	GENERAL	TOTAL
	[OF AIR TAXI		AVIATION	1
	1	AND		1	ł
	1	AIR CARRIER		1	Į.
		ARRIVALS		* <u>-</u>	
0000	12	7		2	22
0100	14	10	0	7	25
0200		9	2	0	15
0300	3	2	0	0	
0400	4	6	0	٥	10
0500	5	5		0	11
0600	6	3	6	4	19
0700	17	5	2	5	29
0800	27	10	7	7	51
0900	26		4	9	46
1000	38	10	. 5	P	61
1100	43		7	В	71
1200	70		4	9	50
1300	28	6		10	46
1400	35		4	10	60
1500	19		5	11	42
1600 to	271	67			4
2400	4		33	52	423
TOTALS	582	185	83	/36	986
		<u>DEPARTURES</u>			
0000	22	4	2	2	30
0100	8	19	0	0	22
0200	4	6			
0300		4			. 5
0400	4	3			R
0500	4				12
0600	10		4	,	21
0700	30	/3	6		55
0800	49	13			74
0900	42	10	<u> </u>		12
1000	34				
1100	34		4		60
1200	. 34 .	-/5	_5		74
1300	43		<u></u>	10	- 82
1400	32			12	47_
1500 1600 to	30			7	49
	213	69			
			32 84	44	358
2400 TOTALS			yar I	126	1005
	571	204			7.7.0
	CL	ASS DISTRIBUT	ION (0000 to	2400)	7.5
TOTALS					74

TABLE 6
1987 DEMAND

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI AND AIR CARRIER	AIR TAXI	GENERAL AVIATION	TOTAL
	 	ARRIVALS			
0000	1 77	4	0	1	17
0100	13	8	· · · · · ·		25
0200	5	7		0	13
0300	5			Ú	- / - /
0400	4		4	0	
0500	4	3	7	0	R
0600	7	0	5	4	16
0700	18		5	5	29
0800	31	3	7	7	48
0900	23	3	2	9	37
1000	37	3	6	8	539
1100	44	4			62
1200	32	3		9	49
1300	28			10	40
1400	32	4	4	10	50
1500 1600 to	27				42
2400	277	13	33	52	375
TOTALS	598	62			
TOTALS	370		8.3	136	879
		DEPARTURES			
0000	22	0	2	2	26
0100	8	12	0	0	20
0200					
	4	5	1		
0300	0	3		0	10
0400	4	2		0	10
0400 0500	0		1	0	. 4
0400 0500 0600	0 4 4 10	2 5 2	1	0	10 4 7 10
0400 0500 0600 0700	0 4 4 10 30	\$ 2 6	0.4	0 0 0	10 . 4 . 7 . 10 . 18 . 48
0400 0500 0600 0700 0800	0 4 4 10 30 50	2 2 6 3	1 1 0 4 6 3	0 0 1 2	10 7 10 18 48
0400 0500 0600 0700 0800 0900	0 4 4 10 30 50 43	\$ 2 6 3	3 5	0 0 1 2	10 4 7 10 18 48 65
0400 0500 0600 0700 0800 0900 1000	0 4 4 10 30 50 43	\$ 2 6 3 2	3 5	0 0 1 2 6 9	10 4 7 10 18 48 65 55
0400 0500 0600 0700 0800 0900 1000	0 4 4 10 10 50 43 35	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	3 5		10 4 7 10 18 48 65 55 49
0400 0500 0600 0700 0800 0900 1000 1100	0 4 4 10 10 50 43 35 35	2 2 6 3 2 2 2 7	3 5		10 4 7 10 18 48 65 55 49 52
0400 0500 0600 0700 0800 0900 1000 1100 1200 1300	0 4 4 10 10 50 43 35 35 43	2 2 6 3 2 2 2 7	3 5	0 2 2 6 9 5 4 11 11	10 4 7 10 18 48 65 55 49 52 66
0400 0500 0600 0700 0800 0900 1000 1100 1200 1300	0 4 4 10 10 50 43 35 43 44	2 2 6 3 2 2 2 7 0	3 5		10 4 7 10 18 48 65 53 49 52 66 53 42
0400 0500 0600 0700 0800 0900 1000 1100 1200 1300 1400	0 4 4 10 10 50 43 35 35 43	2 2 6 3 2 2 2 7	3 5	0 2 2 6 9 5 4 11 11	10 4 7 10 18 48 65 55 49 52 66
0400 0500 0600 0700 0800 0900 1000 1100 1200 1300 1400 1500	0 4 4 10 10 50 43 35 35 43 44 23 30	2 2 6 3 2 2 2 7 0 0	3 5	0 2 2 6 9 5 4 11 11	10 4 7 10 18 48 65 53 49 52 66 55 42 43
0400 0500 0600 0700 0800 0900 1000 1100 1200 1300 1400 1500 1600 to	0 4 4 10 30 50 43 35 35 43 44 23 30	2 2 6 3 2 2 2 7 0 0	3 5	0 2 2 6 9 5 4 11 11 10 12 7	10 4 7 10 18 48 65 55 49 52 66 53 42 43
0400 0500 0600 0700 0800 0900 1000 1100 1200 1300 1400 1500	0 4 4 10 10 50 43 35 35 43 44 23 30 215 600	2 5 2 6 3 2 2 2 7 9 0 0 2 4 75	4 3 3 5 6 4 7 7 6 32 84	0 0 1 2 6 9 5 5 11 11 10 12 7	10 4 7 10 18 48 65 53 49 52 66 55 42 43
0400 0500 0600 0700 0800 0900 1000 1100 1200 1300 1400 1500 1600 to	0 4 4 10 10 50 43 35 43 44 23 30 215 600	2 5 2 6 3 2 2 2 7 0 0 0 2 4 75 ASS DISTRIBUT	3 3 5 4 5 1 7 6 32 84 100 (0000 to	0 0 1 2 6 9 5 1/ 1/ 1/ 10 12 7 44 126	10 4 7 10 18 48 65 55 49 52 66 53 42 43
0400 0500 0600 0700 0800 0900 1000 1100 1200 1300 1400 1500 1600 to	0 4 4 10 10 50 43 35 35 43 44 23 30 215 600	2 5 2 6 3 2 2 2 7 9 0 0 2 4 75	4 3 3 5 6 4 7 7 6 32 84	0 0 1 2 6 9 5 5 11 11 10 12 7	10 4 7 10 18 48 65 55 49 52 66 53 42 43

TABLE 7
1987 DEMAND WITH PEAKS

TIME	AIR CARRIER	SUPPLEMENTS OF AIR TAXI	AIR TAXI	GENERAL AVIATION	TOTAL
1		AND			•
		AIR CARRIER		L	
		ARRIVALS			
0000	11	4	0	2	17
0100	13	8	,	7	23
0200	5	7	1	0	13
0300	5			6	7
0400	4				9
0500	4	3			
0600	7			4	
0700	18				29
0800	31	8		7	23
1000	25	3			37
1100	37	3			Ġ.
1200	32	3			68
1300	28	0	2	10	49
1400	32	4	4	10	50
1500	27	0	4	11	42
1600 to					-7.
2400	277	13	35	52	375
TOTALS	598	7.3	83	136	890
		DEPARTURES			
0000	22	0	2	2	26
0100	8	12	0	0	20
0200	4	5		0	10
0300	0	3			. 4
0400	4				
0500	4				10
0600	/0	2	4	2	
0700 0800	30	6			48
0900	50	8		9	70
1000	35	2	خ خ		<i>\$\$</i>
1100	35	2	- 6	-	52
1200	43	14		11	73
1300	44	0		10	55
1400	23	0	7	12	42
1500	30	0	6	7	42
1600 to					
2400	215	24	32	44	315
TOTALS	600	87	84	126	897
	CL	ASS DISTRIBUT	TION (0000 to	2400)	
	Class 1	Class 2	Class 3	Class 4	
	27.0 %	54.2 %	13.8 %	5.0 %	

TABLE 8

ANALYSIS OF YEARLY TOTAL for PASSENGER and AIRCRAFT OPERATIONS

	1978	1982	1982 +5%	1982 +15%	1987
Total Daily Air Carrier					
and Air Taxi Operations	1448	1473	1556	1729	1502
Total Departures (avg.)	724	737	778	865	751
% of Class 1	22.7	25.2	25.2	25.1	28.5
Class 2	58.4	58.0	58.1	58.2	56.9
Class 3	18.9	16.8	16.7	16.7	14.6
# of Seats per Aircraft (avg.)					
Class 1	280	300	300	300	300
Class 2	140	160	160	160	170
Class 3	16	20	20	20	25
Occupied Seats Per Air- Craft (avg.) (L.F.=0.65)	100 0	105.0	105.0	105.0	
Class 1	182.0	195.0	195.0	195.0	195.0
Class 2	91.0	104.0	104.0	104.0	110.5
Class 3	10.4	13.0	13.0	13.0	16.5
Daily Passenger Totals (avg.)					
Class l	29,911	36,216		42,337	41,736
Class 2	38,476	44,455	47,009	52,356	47,218
Class 3	1,423	1,609	1,689	1,878	1,809
TOTAL	69,810 <u>x60</u>	82,280 <u>x60</u>	86,928 <u>x60</u>	96,571 <u>x60</u>	90,763 <u>x60</u>
July-August Passenger Enplanements	4,188,600	4,936,80	0 5,215,6	80 5,794,	260 5,445,780
TOTAL + % of Yearly totals	÷ 0.25	÷ 0.25	÷ 0.25	÷·0.25	+ 0.25
Yearly Passenger Count (Enplanements) x 1000	16,754	19,747	20,862	23,177	21,783

TABLE 8 (cont.)

ANALYSIS of YEARLY TOTAL for PASSENGER and AIRCRAFT OPERATIONS

	1978	1982	1982 +5%	1982 +15%	1987
Total Daily Air Carrier and Air Taxi Operations	1448	1473	1556	1729	1502
	x60	<u>x60</u>	<u>x60</u>	<u>x60</u>	<u>x60</u>
	86,880	88,380	93,360	103,740	90,120
July-August Aircraft Operations : % of Yearly Total	÷0.19	4 0.19	* 0.19	‡ 0.19	÷0.19
Yearly Aircraft Count (Air Carrier and Air Taxi)	457,263	465,157	491,368	546,000	474,315
GA Count	+53,000	+53,000	+53,000	+53,000	+53,000
TOTAL	510,263	518,157	544,368	599,000	527,315

2.3. Experimental Results.

Each experiment produced a summary of hourly results which was reduced to tablular form. The information in the table included: average flow rates for each runway, average total flow rate for the airport, average arrival and departure delays for each runway (including average delay for all runways), average runway crossing delays, average taxiway delays and average gate hold conditions. In addition, average travel times were listed for airborne arrivals (arrival fix to threshold), arrival ground travel (threshold to gate) and departure ground travel (gate to roll including gate hold time). The tables for each experiment are shown in Appendix B.

The summaries of the experiments were used to calculate the total delays and the travel times accumulated during each hour of the simulation. The delay and travel times were added for each experiment (8 hour totals for daytime and 7 hour totals for nighttime). The results of this data reduction are shown in Tables 9 to 11. The tables list sets of experiments which have common weather conditions, traffic flow, etc.

The runway capacity model was exercised during the effort to determine the capacity of the airport during tunnel construction. The results of the experiments (17A, 17B and 17C) are shown in Tables 12 and 13.

The results of the simulation model runs formed the basis for calculation of the annual delays for the airport. Experiment 1 was rerun for a time period from 0700 to 2400 and served as a guide for calculating the total delay for an average day. The results of this simulation, shown in Table ,

Appendix B, indicate that about one-half of the arrival delays for operations from 0700 to 2400 occurred in the first eight hours of the simulation. Delays from the simulation were combined with the delays from the nighttime operations and used to calculate the annual delay. It was assumed that the average day was representative of two months of activity which comprised about 19% of the total delays. The results of the simulation experiments whose conditions matched those required for the annual delay calculation were used as a base for the determination of total annual delay.

TABLE 9

RESULTS OF VFR -- WESTERLY FLOW

[<u>.</u>	1:	7	1	. 2	T 2	9	12	й	18	IN	9
	S TOTAL	(1)	36	4 7 7	+			10742	11342	10759	10552	0250/
	AL ARRIVAL DEPARTURES	GROUND SC 77	80	7905	16884	8897	1801	5304	5705	5349	5175	5/5/
	ARTVAL	/5.29	0/9/	1708	1907	1891	150/	1191	1623	1625	1629	1586
	2	4077	4027	5/23	1339	4709	3717	3828	31/4	3786	3748	3823
17000	GROUND	3477	3336	557.2	8587	5583	3/06	3026	333/	2411	2980	2873
	GATE	7.	8	233	8/11	//33	9	77	27	3,	2	ŭ
Variation V		~	0	+	4	4	8	8	0	01	0	∞
DEPARTIES NOT AV	TAXI	182	525	897	1881	1357	444	468	125	185	6.53	424
DEPAR	EUNHAAY	2772	2518	4/87	5541	4130	2018	2380	3232	7722	2190	2346
(minutes)	RUMMAY X-1NG	80	18	1119	105	801	87	88	59	0,9	23	45
DELAY (IXXI	*	57	"	778	123	58	19	48	48	55	39
ARRIVAL DELAY		803	643	15%	12.25	/358	405	436	3//5	382	404	525
AIR TRAFFIC	SE PARATIONS	9281	8281	1978	1978	7881	1987	1982	1982	1887	7881	1978
EXP. DENAMB ARRIVAL DEPARTURES THENOVENEURS AIR TRAFFIC		NoNE	Jholi	Novk	JNON	NEAR TERM	NEAA TEAM	Aurent Ach	DUAL TAKIWAY	DUAL TAKI WAY	DUAL TAXIWAY	HOISHWAZ L
DEPARTURES	E E COULTE D	ı	ł	1	_	-	SENT FROM		.1	DEPARTURES SENT FROM 25R TO AYR		
TVALETY	HODIFIED		-	-		1	ı	1	i	1	1	1
		1978	1982	1982	1182	1182	7861	1982	1982	1987	1982	1982
E.		न	7	Z	82	π	11	13	18	18	181	1111

TABLE 9 (cont'd.)

RESULTS OF VFR -- WESTERLY PLOW

. 1				 .						 	 _
	TOTAL		93201	(59/9	7853	15547	6022	986	12/53		
	DEPARTURES	CHOUND	32,	7664	9082	1006	3579	4455	61.59		
	TRAVEL TIMES	GROUND	1500	1672	2/00	2101	1452	1505	239/		
	2	AIA 3 2.87	194	(383	4403	###	3720	3899	4340		
		3084	3398	55/3	1887	#33	1639	2524	3849		
7	GATE	52	28	694	44	1048	7	22	5		
,	RUMAAY	X-1NG	9	۲	*	1	`	_	0		
THIS NEW	MAY TAKI RUMAY GAT	432	588	355	1450	1359	245	415	009		
Addi	RUMAKY	2494	2008	1343	4200	4071	1325	1957	2925		
DELAY (minutes)	RUMAAY	15	(3	3/	11	"	32	38	0/		
		48	*	57	133	/87	34	40	65		
ARRIVAL	RUMAAY	120	40	3073	993	1034	181	257	469		
AIR TRAFFIC	SEPARATIONS	1982	1982	1978	1978	8781	1987	1987	1978		
DEPARTURES INPROVIDENTS AIR TRAFFIC		TERMINAL EXPANSION	REMOTE	RUMWAY 25K TUMBEL CONSTALCTION	RUNANY 25A TUNNEL CONSTAUCTION	ROWANY 25K TUNNEL WITH DUAL FARIWAY	FAR TEAM	FAK TERM	AUNIWAY 25L TUNNEL CONSTRUCTON		
DEPARTURES	REBOUTED	-	1	1	DEMANNES SENT FROM 25L D 24K	H			DEMATURES SANT FROM ASK TO 24K		
_	MENAND HODI FIRD	1	1		1	1	-	-	SO AMINALI ON 259 CHANCO To 2018		
SENATE		1881	787	1982	1982	1887	1887	1981	1982		
EXP.		20	n	44	*	220	25	258	35		

TABLE 10

RESULTS OF IFR -- WESTERLY FLOW

		_	DEPARTURES	DEPARTURES INCROVEMENTS AIR TRA	AIR TRAFFIC		ARRIVAL DELAY (minutes)	dautes	DEPAR	DEPARTURE DELAY (mir.	V Carleton						
		HOUTTED	MEMORYED		SEPARATIONS	BUNKAY	LYXI	RUMAAY	RUMMAY	TAXI	RUMMAY	CATE		E	ARRIVAL A	L ARRIVAL DEPARTURES	TOTAL
7	1178	ı	i	ZHOM	1178	8235	25	35	2/70	00/	X-1160	6)	2424	AIR	GROUND	CHOKIND	,
*~	22	257 00 00 00 00 00 00 00 00 00 00 00 00 00	1	JNON	1978	***	35	0,9	2895	128	, 4	3/2	2437	77.75	1	13.24	1687/
×	1978	2	ı	NoNE	1978	7007	1054	94	1535	14%	7		16222	9670	1578	3577	14755
X-00	182	to Activity	1	Non	19.78	\$100	37	ß	27/4	1/4	7		3288	8524	1578	5568	17270
84	1881 +57	53.4.4.111455 0N 2 54 C/My 4 60		NoNE	1178	7945	36	52	3777	178	T	114	452	"111	1573	7129	19 (30
88	1982 +15%	61 AMINAS 04 254 CHANGEO TO 24A	l	3NaN	1978	12703	18	5.6	2442	297	7	2285	8163	/6030	1/48	10000	76277
12	7861		ı	NEAR	1982	5046	55	57	2373	165	77	223	2874	8279	7651	4810	14601
77	1987	50.44 CE 0	SENT FROM 25R TO 24L	NE AR TEAM	1962	2321	50	578	27//3	189	9	290	3307	3406	1665	544	73216
23	788	_		RUNWAY 25R TUNNEL CONSTRUCTION	1978	4776	13/	17	52%	33/	~	43/8	9448	7353	1757	1/343	10452
24	1982	-	١	RUNWAY 25L TURNEL CONSTRUCTION	1978	2965	108	18	6327	199	0	3112	1466	3656	1893	11386	HOEE
24	1982	1	DEMATULES SENT FAM 25R TO 34L		1998	SMS	1/3	22	6020	394	0	4872	bbhil	6626	1161	13505	155%
1 8	18/10/11			To Die selection of the													

* ORIGINAL ARRIVAL RUNDAY DISTRIBUTION OF TRAFFIC DEMAND HAS BEEN NOOIFIED

TABLE 10 (cont'd.)

RESULTS OF IFR -- WESTERLY FLOW

F	Ţ	Ö	7	7 2	-	_	7 -			_		 <u> </u>	\overline{T}		T		
	TOTAL	9920	0 1942	Close	2							<u> </u> 					
	ARRIVAL AMRIVAL BEPARTURES	Chount 4010	86011	77711													
194	ARRIVAL.	CHOUND 1517	1537	767/													
	ARRIVAL.	4392	93,9	6116													
TOTAL	CROUND	2150	9153	4546													
utee	CATE	79	3339	3512					•								•
DEPARTURE DELAYS (plantes	RUMUAY	~	0	"													
TURE DEL	TAXT	98	344	328													
DEPAR	MUNITALY	1923	5465	8bhs												T	
(mutes)	KUNNAY X-TH2	35	14	15													
DELAYS(=	17/71	23	18	95							•						
1-	RUMMAY	831	6297	6535								•				1	
AIR TRAFFIC	SK PARATIONS	1861	1978	1978													
ERP. DEMAND ARRIVAL DEPARTURES INCROVENERTS AIR TRA		FAR TERM	KWWAY LEL TWWSL CONSTRUCTION	Comment 25K												-	
DEPARTURES	KEROUTED	1	So Menus Penatures of 35h Sent Frances Charles Sent Frances	DEMENDES SENT FRAM 15K TO 34L													
ARRIVAL	NODIFIED	1	Sp. 246 CHAMER D CHAMER D CHAM	Sallier 's									-				
		1987	784	1987										1			
EXP. IL	1	*	36	33										†			

TABLE 11

RESULTS OF VFR -- EASTERLY PLOW

AND NIGHTTIME OPERATIONS

	Beats if	P.Y.P. I ROLL WITH A DE TWAT	A						2112			-					•
_		THE PARTY.	PERCHASIS.	PERMITTED LINERDVENERING AIR TRAFFIC	AIR TRAFFIC		ARRIVAL DELAY (minutes)	mutes)	DEPART	DEPARTURE DELAY (minutes)	(alout		- TALLET			2 2 140 140 140	
		HODITIED			SE PARATIONS	RUNEAY	1772	X-THO	RUNHAY	TAXI	RUNINA	GATE	-	VERTVAL	ARRIVAL	ARRIVAL ARRIVAL DEPARTURES	TOTAL
•	1178	1	1	NoNE	8261	1405	109	50	3633	1052	A-1.10	. 0/9/	DELAYS	AIR	GROUND	CROUND	
*9	1978	子を変え	1	NoNE	81.41	3	1	1:			,		#2	7637	4667	1042	14787
1		13 AANIMUS			2		;	*	25.46	200	0	384	3745	3969	1631	2107	1/638
Fa-	787	CHANGED PAN M. R. Te Ca	ı	NONE	82 81	408	85	57	2370	706	0/	19	3302	3185	1595	5072	10652
18.	1982	"		HIGH SPEED 21/73, Award 21/73, Award	1882	332	22	2	11.52	309	2	73	2795	3618	1602	1888	10399
44	1978	ARA MASS	1	3hoN	1978	374	٣	0	457	ρ,	0	0	405	/358	376	37.92	49.52
10	7861		1	NonE	878	1035	4	0	989	15/	0	0	705	1961	181	1245	37/0
15°	1987		1	HIGH SPECO EXITS	1987	844	4	0	219	151	0	0	135	18 00	502	1203	3.62
*1,	8181	ALL AGRICALL PLACE DO		Nove	19.78	1245	4	0	1130	6	0	0	1/39	2/42	466	1647	42.57
* VO!	1182	"	_	ЭноН	1982	2048	4	0	1285	/3	0	0	1302	3001	197	1825	5325
*	A141.21.0.	M. C.D. L. Cont.		A Secretary of the Control of the Co	١,	TA 4 C.C. 10 C. 10	4000		77.00	100							

* ORIGINAL ARRIVAL RUNINAY DISTRIBUTION OF TRAFFIC DEMAND HAS BLEN MODIFIED

TABLE 12

1982 VFR CAPACITY RESULTS -- NO NOISE CONSTRAINTS

24R, 24L and 25L -- MIXED OPERATIONS

NO NOISE RESTRICTIONS

Because of mixed operations on both runways on the north complex, there is an estimated 5% departures capacity loss due to crossover departure paths on the ground. The departure capacity was 35 for the north complex for all arrival percentages (40%, 45%, 50%, 55%, 60%). A 5% departure capacity loss (2 departures) resulted in a departure capacity of 33 on the north complex.

Puntraya	Hou 40%	rly Capa 45%	city By 50%	% Arriva	ls 60%
Runways 24R, 24L	99	100	100	101	102
25L	55	55	55	55	55
All 3 Runways	154	155	155	156	157

(Note: The capacity figures listed above reflect the 5% departure capacity loss.)

TABLE . 13

1982 VFR CAPACITY RESULTS -- RELAXED NOISE CONSTRAINTS

24R -- ARRIVALS

24L -- DEPARTURES

25L -- MIXED OPERATIONS

The relaxed noise restrictions were the result of running on arrivals on 24R.

			city By		
Runways	40%	45%	50%	55%	60%
24R, 24L	91	86	77	70	64
25L	55	55	55	55	55
			·		
All 3 Runways	146	141	132	125	119

2.4. Comparison of Experimental Results.

The comparison of experimental results was directed towards satisfying the objectives of the effort and determining:

- 1. The effects of demand on delay.
- 2. Peak average delays and annual delay values.
- 3. Demand versus delay comparisons for increases in total daily demand.
- 4. The percentage of reduction in delay, travel time and estimated annual delays due to proposed procedures, hardware improvement options and airport design improvements for near-term and long-term implementation.
- 5. The effects of tunnel construction on delay.
- 6. The interdependence of terminal facilities, airport design procedures, fleet mix and air traffic demand on airport operations.

The following comparisons were made:

- 1. 1978 operations with 1982 do-nothing case.
- 2. 1978 operations with 1982 do-nothing cases varying the 1982 demand.
- 3. 1982 do-nothing case with 1982 separations and near-term improvements.
- 4. 1978 operations with the 1987 separations and long-term improvements varying the 1987 demand.
- 5. Sequences of tunnel construction activities with 1982 do-nothing case.
- 6. 1982 separations and dual taxiway improvements with 1982 do-nothing case.
- 7. Near-term improvements with dual taxiway improvement.
- 8. Departure by-pass around runway 24L with dual taxiway improvement.

- 9. 1982 do-nothing case with 1982 separations, high speed exits off of runways 6R and 7L and departure by-pass around runway 7L.
- 10. Do-nothing 1982 case with terminal expansion and the presence and absence of 1982 separations.
- 11. Remote terminal with dual taxiway improvement.

(NOTE: The 1982 do-nothing case refers to 1978 operations with a 1982 demand.)

COMPARISON OF 1978 OPERATIONS WITH 1982 DO-NOTHING CASE

(1978 OPERATIONS USING 1978 and 1982 DEMANDS)

The basis for comparing these simulation experiments (1978 operations) includes all combinations of easterly and westerly traffic flow, VFR and IFR weather conditions, and daytime and nighttime operations under both 1978 and 1982 demands. These configurations represent those exercised during the year at Los Angeles International Airport.

EXPERIMENTS

CONFIGURATIONS

(1978 and 1982 - respective demands)

#6 (Modified) and #9 (Modified)

#1 and #7

VFR-Daytime-Easterly Flow

VFR-Daytime-Westerly Flow

#4(Modified) and #10(Modified)

VFR-Nighttime

#2(Modified) and #8(Modified)

IFR-Daytime-Westerly Flow

#5(Modified) and 10A(Modified)

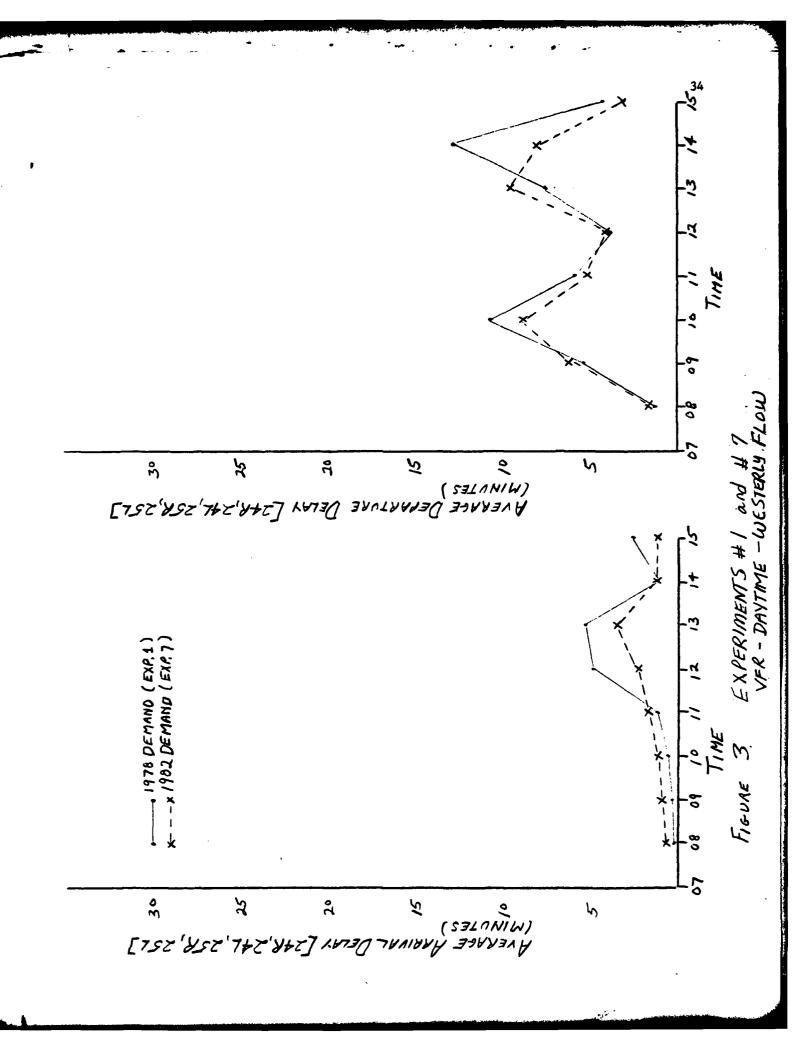
IFR-Nighttime

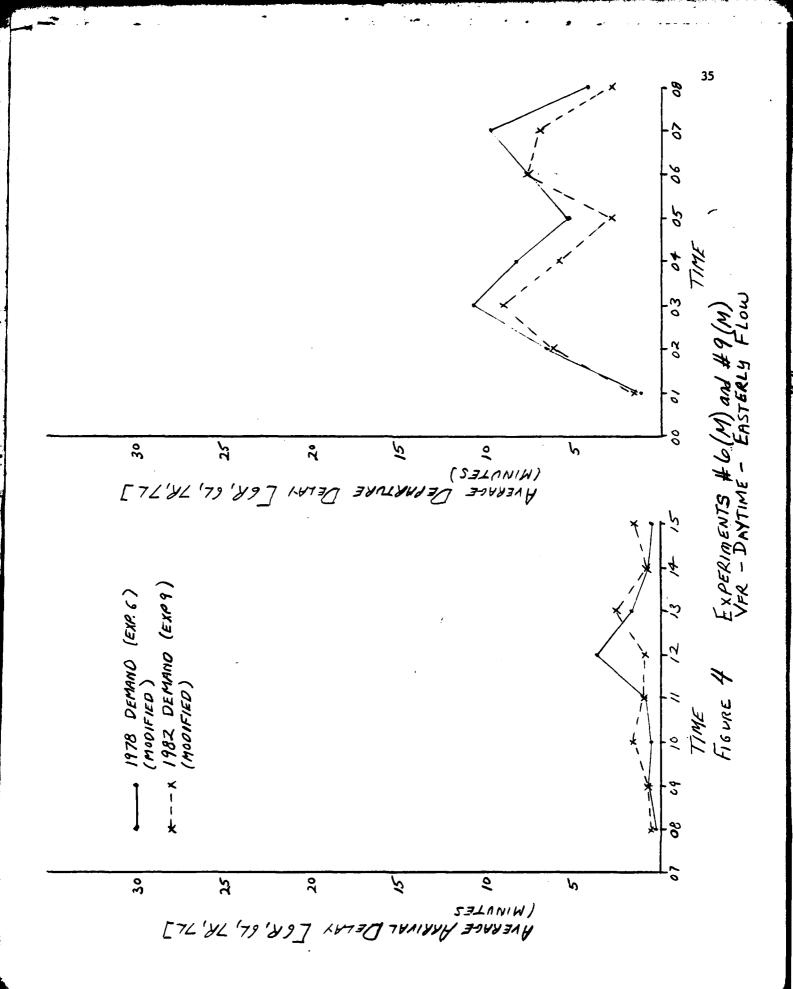
Figures 3 through 7 show the average delays for arrival and departure runways. Table 14 gives a direct comparison of the experiments showing the total delays and travel times accumulated during the simulation.

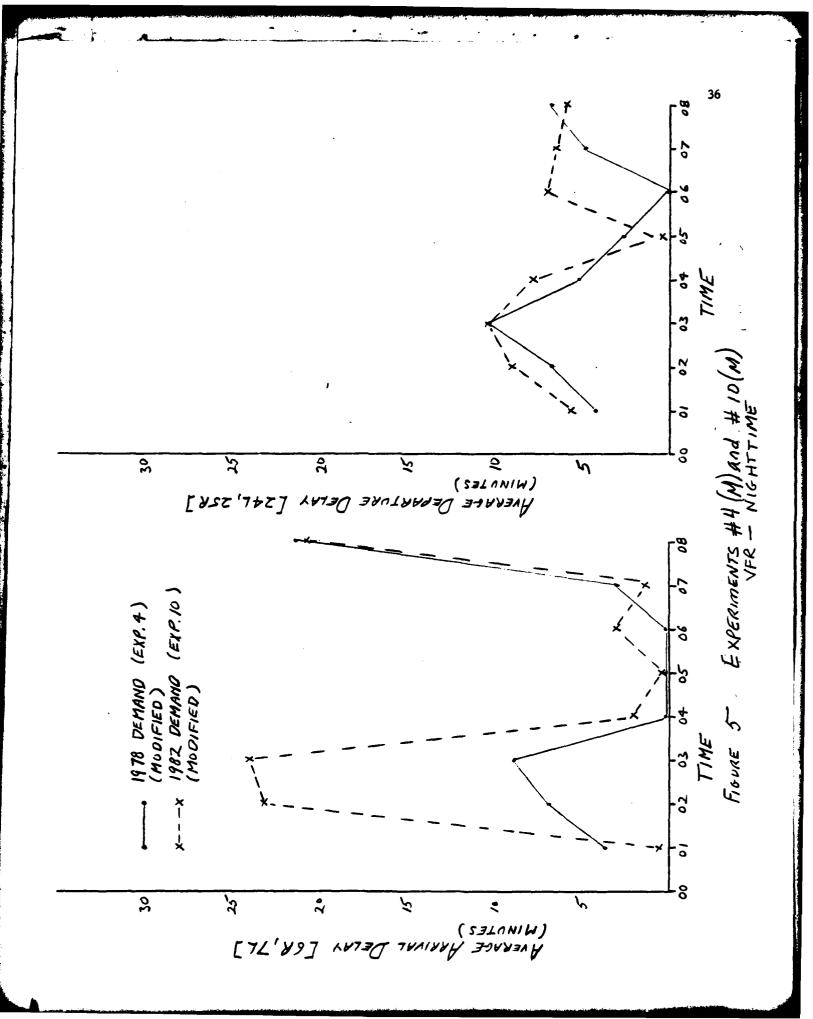
The results of each comparison are noted on the table.

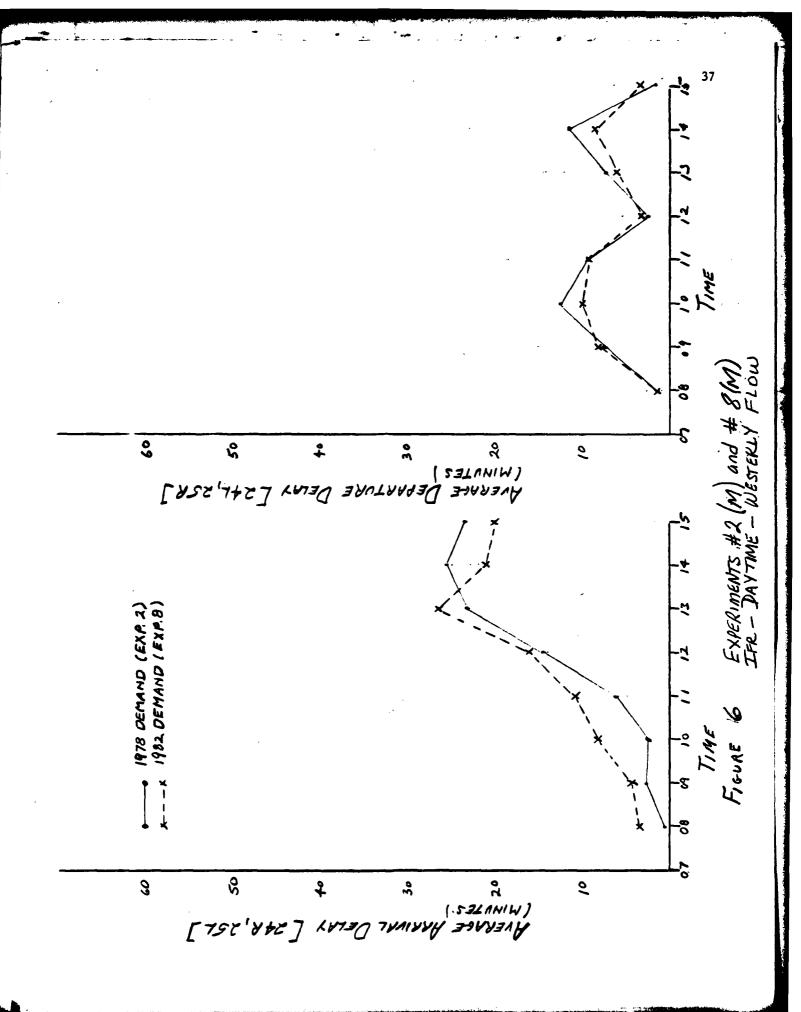
Compared to 1978 levels, the 1982 demand, fleet mix and distribution of traffic over the runways and gates produced slightly less delays for VFR conditions, but higher delays and travel times for both IFR weather conditions and nighttime operations.

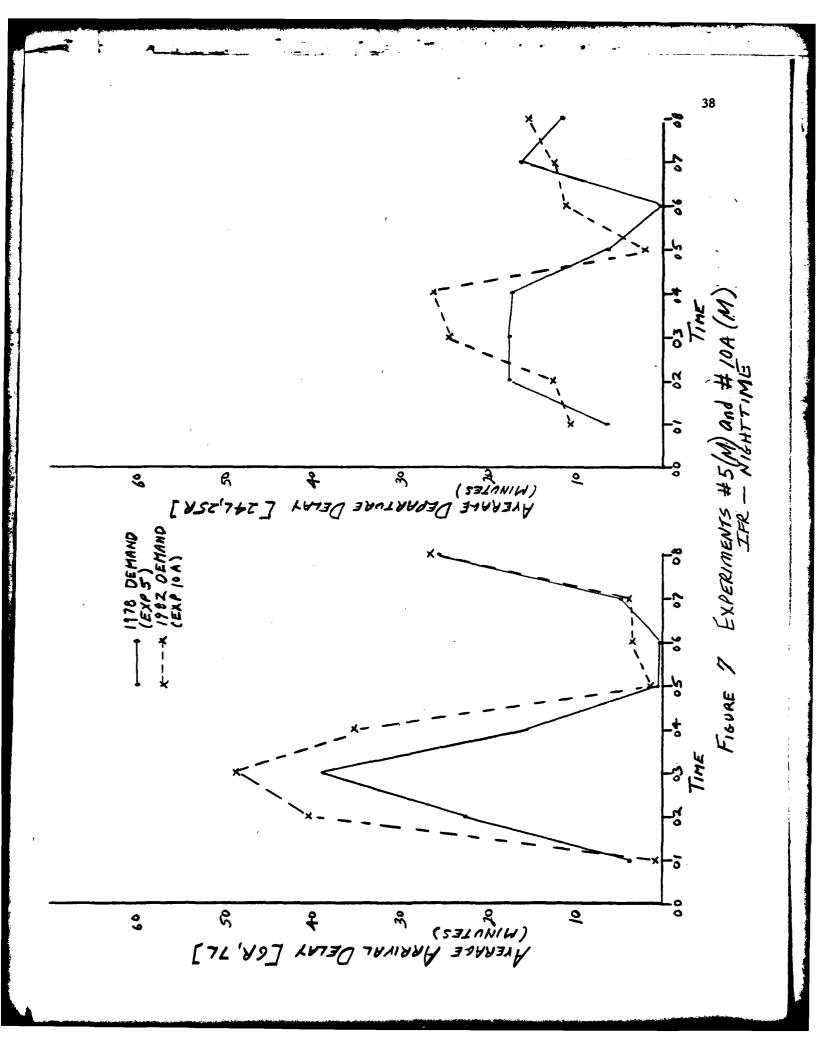
Tables 15 and 16 show the peak average delays and annual delay estimates for the 1978 operations and the 1982 do-nothing case.











1978 OPERATIONS WITH 1982 DO-NOTHING CASE

	PENAME	ARRIVAL.	BEPARTURES	EXP. DEMAND ABRITAL DEPARTMES INPROVEMENTS AIR TRAFFIC ABRIVAL DELAY (miguides)	AIR TRAFFIC	ARRIVAL"	DELAY (stautes)	DEPART	URE DELA	Y (minut	()	TOTAL	174	VEL TIMES	(mfautes)	
		MENAND HODIFIED	DEMAND REPOUTED HODIFIED		SE PARATIONS	RUNDAY	TAXI	RUNKAY X-1NG	K-ING RUNKAY	TAXT	RUMAAY X-14G	CATE	GROUND	ARRIVAL Atr	ARRIVAL. Cround	RUNIAY TAXI RUNIAY GATE GROUMS ARRIVAL ARRIVAL DEFARTURES 10141.	FOTAL.
#	1 1978			None	1978 (VFR) 803		46	80	76, 80 2792 482	482	~	*	3477	4077	1529	74 3477 4077 1528 5677 11283	1/263
_	2 1883		1	JNON	(1978 (1978)	(VER.) 643 57 81 2598 582	22	18	2598	225	8	3	3336	4427	0/9/	30 3336 4027 1610 5659 11296	1/296
	LESULTS:	The 1982	demand resu	AESULTS: The 1942 demand resulted in reduced arrival and departure delays due to the change in the sircraft mix and the distribution	ed arrivel en	d departu	re dela,	re due to	the char	nge in ti	be strer	# # # # # # # # # # # # # # # # # # #	and the d	isetribut s	8		

_			_
	#638	10652	
	2109	5672	
	/8/	1575	
	578.5	3302 3185 1595 SO72	
	384 3745 588	3302	
	384	23	
	9	0/	
	909	406	
	42 2596 606	2370	
	42	25	
	3)/	58	
	460	408	
	1978 (VFA)	1978 (VIR)	
	None	None	
	CHANGE CONTROL OF THE PARTY OF THE PARTY P	43 AMDWAS CHAMSCO FLAM 74. 74	
	1978	1987	
I	*9	9*	
-			

RESULTS: The 1982 desend resulted in reduced arrival and departure delays due to the change in the aircraft mix and the distribution of the air traffic desend over the runways.

4 1978 Anteriorus 1000E 1978 (VFR) 374 3 0 457 5 0 0 465 1558 376 3198 4933 10 <	79		Ī
1978(VFR) 374 3 0 457 5 0 0 465 1358 376 1978(VFR) 1035 4 0 666 15 0 0 705 1986 481	4 12	37/	
1978(VFR) 1035 4 0 686 15 0 0 705 1986	3196	1243	
1978(VFR) 374 3 0 457 5 0 0 465 1978(VFR) 1035 4 0 666 15 0 0 705	376	181	
1978(VFR) 374 3 0 457 5 0 0		1986	
1978(VFR) 374 3 0 457 1978(VFR) 1035 4 0 666 13	465	745	
1978(VFR) 374 3 0 457 1978(VFR) 1035 4 0 666 13	0.	•	
1978(VFR) 374 3 0 457 1978(VFR) 1035 4 0 666 13	•	0	
1978(VFR) 374 3 0 1978(VFR) 1035 4 0	6	15	
1976 (VFR) 1978 (VFR)	457	929	
1976 (VFR) 1978 (VFR)	0	0	
1976 (VFR) 1978 (VFR)	٣	4	
19261	374	1035	
4 1978 ARBITANS HONE 10 1982 "	1976 (VFR)		
4" 1978 AREINAS Pageso we 10 1982 "1	None	NonE	
1978 Attendas Andervas 10 1182 "			
4* 1978	ALL AREVALS PLACED ON	"	
*4 *2	1978	1182	
	4	10	

AESULTS: The 1982 demand resulted in greater arrival and departure delays.

TABLE 14 (CONTINUED)

1978 OPERATIONS WITH 1982 DO-NOTHING CASE

Committee	١																	
AIR AIR X-1NO 2015 128 4-1NO AIR EDWANY TAXT RUNAMAY AIR AIR X-1NO AIR	EXP.	DEDAME	ARRIVAL	DEPARTURES	THEROVENERS	AIR TRAFFIC	VERIVAL	DELAY (1	Amutes)	DEPART	URE DELL	Y (minut	3	TOTAL	T	WIL TIME	(minutes)	
HOME 1978 (FR) 444 35 60 2285 128 + 1978 (FR) 5100 39 63 2714 164 5			DEHAND HODIFIED	PERCUTED		SE PARATIONS	RUMMAY	TAXI	X-ING	RUMMAY	TAXT	X-ING X-ING	GATE	CROUND ARR	ARRIVAL Atr	ARRIVAL CROUND	DEPARTURES Ground	TOTAL.
19 Minnes 1998 158 5100 39 63 2714 164 5	7	81.81	¥ 832		3W0 NJ	1978 (LFR)	##	35		2882	128	+	315	3437	7610	1548	1 !	14755
	' ∞	1982	10 Abliens 10 251 251 251 25 8		NONE	1998 IFR	2100	39	63	2714	+9 /	لم	304	3218	8224	1578	304 3218 8324 1578 5568 15470	15470

RESULTS: The 1982 demend resulted in greater arrival delays and reduced departure delays.

								-								
*4	1978	ALLIANS PLACED W	None	1978 (SER)	1245	+	0	1130	5	0	0	1139	2442	394		4255
* V0/	1982	F	KNE	1178(IEK)	(IFK) 2048	4	٥	1285	13	0	0	792/	3001	447	5591	5323

RESULTS: The 1982 desend resulted in greater arrival and departure delays.

* - Modified Demand

TABLE 15

PEAK AVERAGE DELAY (AVERAGE DAY) (minutes)

EXP	DEMAND	WEATHER	Improvements	SEPARATIONS	DAYTIM ARRIVAL	E DELAY DEPARTURE
1	1978	VPR	NONE	1978	5.3	12.7
7	1982	VFR	NONE	1978	3.5	9.5
2	1978	IFR	NONE	1978	25.7	12.5
8	1982	IFR	NONE	1978	26.6	10.0
					NIGHTT ARRIVAL	IME DELAY DEPARTURE
4	1978	VFR	NONE	1978	8.9	10.3
10	1982	VFR	NONE	1978	24.1	10.2
5	1978	IFR	NONE	1978	38.9	17.6
10A	1982	IFR	NONE	1978	48.8	26.1

TABLE 16
ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNI	IAL DELAY (hou	urs)
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	11,485	26,505	37,991
7,8 & 10	1982	NONE	1978	13,270	26,359	39,630
					JAL OPERATIONS	\$
1,2 & 4	1978	NONE	1978		510	
7,8 & 10	1982	NONE	1978		518	
						<u>-</u>
				AVERAGE AN	NUAL DELAY () DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	2.7	6.2	4.5
7,8 & 10	1982	NONE	1978	3.1	6.1	4.6

COMPARISON OF 1978 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND

(1978 OPERATIONS USING 1978 AND VARIED 1982 DEMAND)

The basis for comparing these simulation experiments (1978 daytime operations) includes the VFR and IFR weather conditions for the westerly traffic flow under these various demands - 1978 demand, 1982 demand, a 5% increase in the 1982 demand and a 15% increase in the 1982 demand.

EXPERIMENTS

CONFIGURATIONS

(1978, 1982, 1982 +5%, 1982 +15%, respectively)

#1, #7, #7A and #7B

VFR-Daytime-Westerly Flow

#2(Modified), #8(Modified), #8A(Modified)

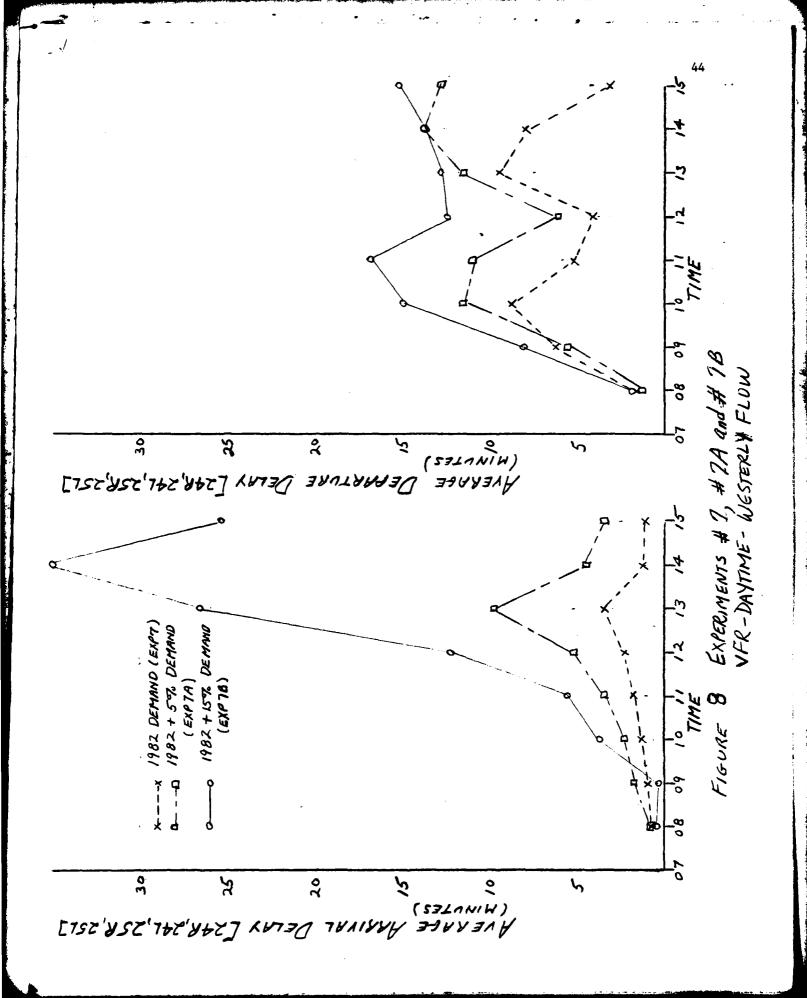
and #8B(Modified)

IFR-Daytime-Westerly Flow

Figures 8 and 9 show the average delays for arrival and departure runways.

Table 17 gives a direct comparison of the experiments showing the total delays and travel times accumulated during the simulation. The result of each comparison is noted in the table.

The effects of the 1982 demands on the peak average delays and the annual delay estimates are shown in Tables 18 and 19.



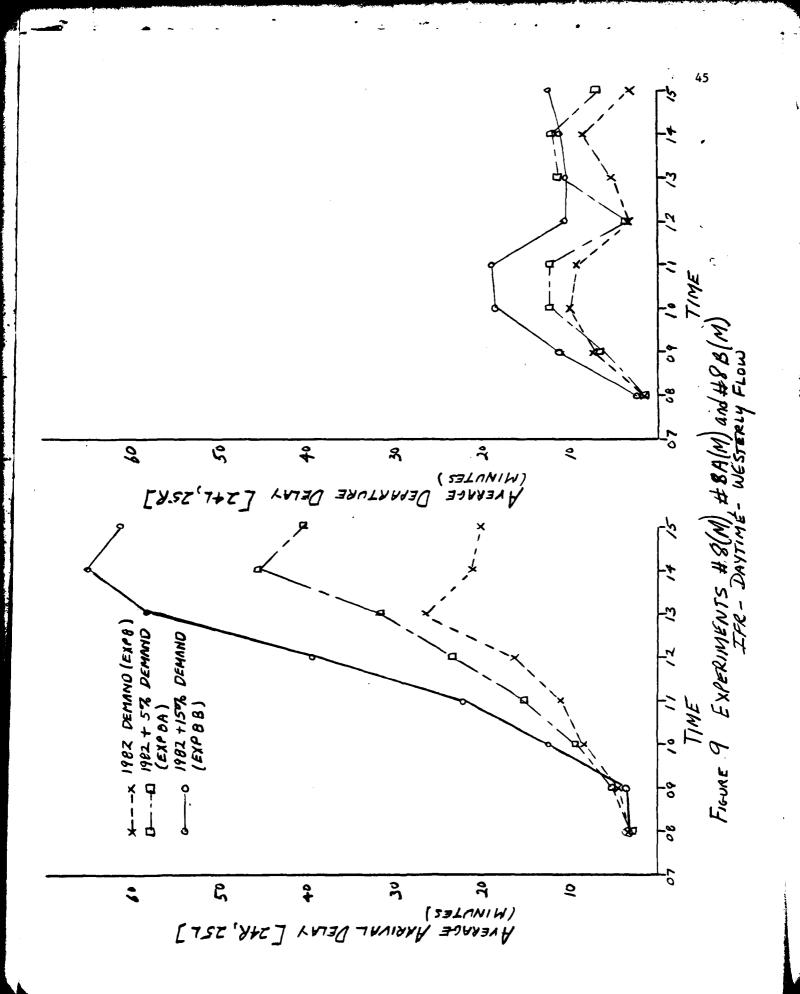


TABLE 17

1982 OPERATIONS WITH 1982 DO-NOTHING CASE VARYING 1982 DEMAND

; Ĭ	Ī	THE LAND	MENTANES	CONTROL DEPARTMES INCROVERENTS AIR TRAFFIC	AIR TRAFFIC	ARRIVAL DELAY (minutes)	DELAY (minutes)	DEPART	DEPARTURE DELAY (minutes)	Y (edmut	(0)	TOTAL.	1	VEL TIMES	TRAVEL TIMES (elmutes)	
•					SEPARATIONS	RUMAKY	TAXI	RUMMAY X-ING	BUNKAY	TAXI	RUWAAY X-ING	CATE	GROUND	ARRIVAL Atr	ARRIVAL GROUND	DR PARTURES Ground	POTAL
•	· ·	÷	ı	None	1976(YFK)	803	46	80	27.92	482	~	4	3477	4077	1529	229.5	11283
	3	'	-	Nowe	1978 (VFR)	643	57	18	2598	282	80	25	3336	4027	0/3/	51.59	11.296
				NoHE	197e(VFR)	1576	9,9	6//	4182	268	4	223	5562	543	1708	7905	#730
	10.7	-	-	NONE	(838 (VFR)	(YFR) 5671	726	705	105 5541	1651	4	8111	8587	9339	1907	10884	22/30
•	173	1.25 Sec. 151.		None	1978 (IFR)	4444	35	9)	28 95	,28	4	3.65	3437	2610	8451	.277	
<u> </u>	187	15 to 10 10 10 10 10 10 10 10 10 10 10 10 10		МонЕ	1970(1778)	5/00	39	29	2714	164	7	304	3208	8324	578	5568	15470
• 3	711.	OFFICE SAL	J	Nene	(471) 6661	7945	36	56	3777	170	\	3//6	4457	1811	1573	711	18539
	11 712	25.	1	None	1978(JER) 12703	12703	10	5,5	5442	287	7	2285	8/13	16 030	1.48	10600	7877
	1										7	1	7				

BESMITS: The 1982 BO-MOTHING CASE resulted in progressively higher arrival and departure delays as the demand

TABLE 18

PEAK AVERAGE DELAY (AVERAGE DAY) (minutes)

EXP	DEMAND	THE A STREET		,		
	DEIMIN	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIM ARRIVAL	E DELAY DEPARTURI
1_	1978	VFR	NONE	1978	5.3	10.6
7	1982	VFR	NONE	1978	3.5	9.5
7 A	1982+ 57	VFR	NONE	1978	9.9	13.8
7B	1982+157	VPR	NONE	1978	35.7	16.9
2	1978	IFR	NONE	1978	25.7	12.5
8	1982	IFR	NONE	1978	26.6	10.0
_8A	1982+ 57	IFR	NONE	1978	45.8	12.1
8B	1982+15	IFR	NONE	1978	65.1	19.0
1						
\int				•	· ·	
	T					

TABLE 19
ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNU	JAL DELAY (ho	urs)
				ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	NONE	1978	11,485	26,505	37,991
7,8 & 10	1982	NONE	1978	13,271	26,359	39,630
7A,8A	1982+ 5%	NONE	1978	21,085	35,204	56,289
7B,8B	1982+15%	NONE	1978	75,102	55,035	130,137
					JAL OPERATION CAL X 1000	S
1,2	1978	NONE	1978		510	
7,8 & 10	1982	NONE	1978	,	518	
7A,8A	1982+ 5%	NONE	1978		544	
7B,8B	1982+15%	NONE	1978		599	
				AVERAGE AN	INUAL DELAY (TOTAL
1,2	1978	NONE	1978	2.7	6.2	4.5
7,8 & 10	1982	NONE	1978	3.1	6.1	4.6
	1982+ 5%	NONE	1978	4.7	7.8	6.2
7B,8B	1982+15%	NONE	1978	15.0	11.0	13.0

COMPARISON OF 1982 DO-NOTHING CASF WITH 1982 SEPARATIONS AND NEAR-TERM IMPROVEMENTS

A 1982 demand is used in all the simulation experiments comparing the 1982 do-nothing case (i.e., 1978 operations) with the 1982 separations and near-term improvements. The basis of these comparisons includes the VFR and IFR weather conditions for the westerly flow of traffic and the VFR conditions for the easterly flow.

EXPERIMENTS

CONFIGURATIONS

(Do-nothing and near-term, respectively)

#7 and #11(Rerouted)

VFR-Daytime-Westerly flow

#9(Modified) and #16(Modified)

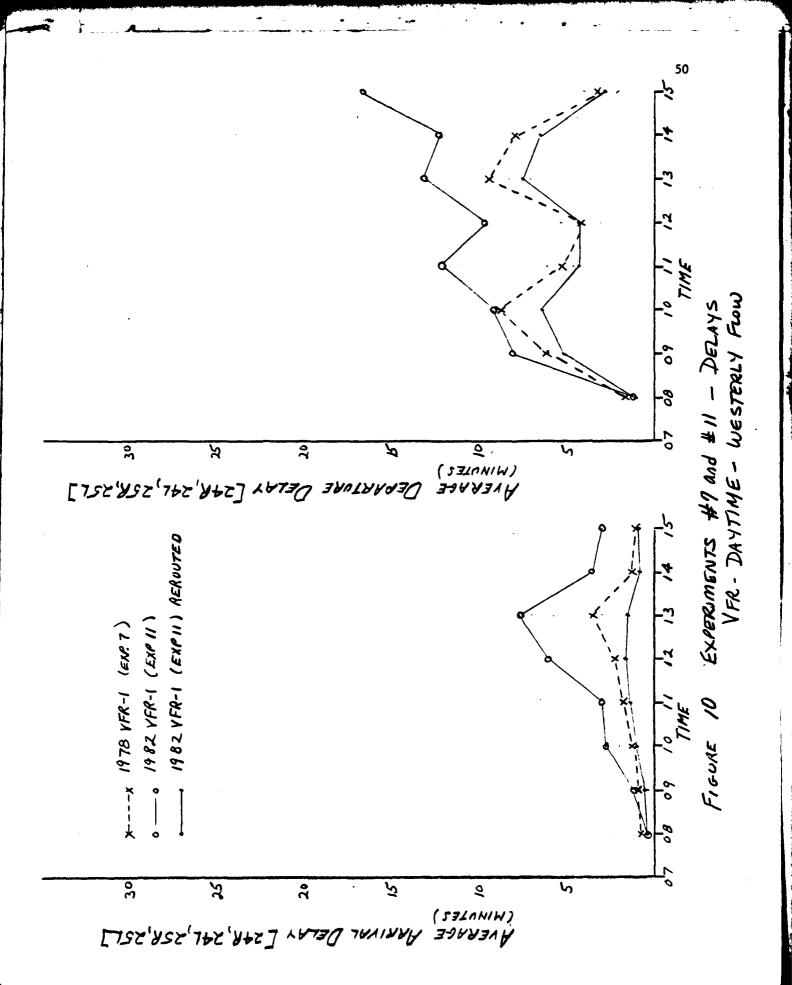
VFR-Daytime-Easterly Flow

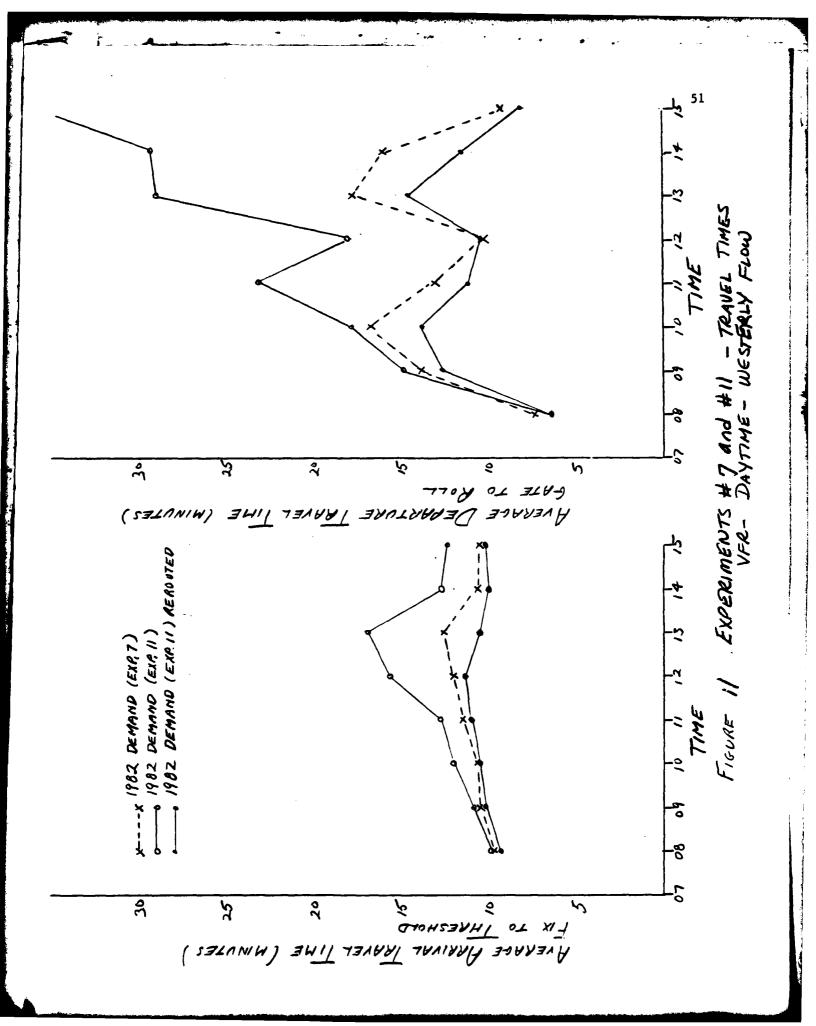
#8(Modified) and #12(Modified and rerouted)

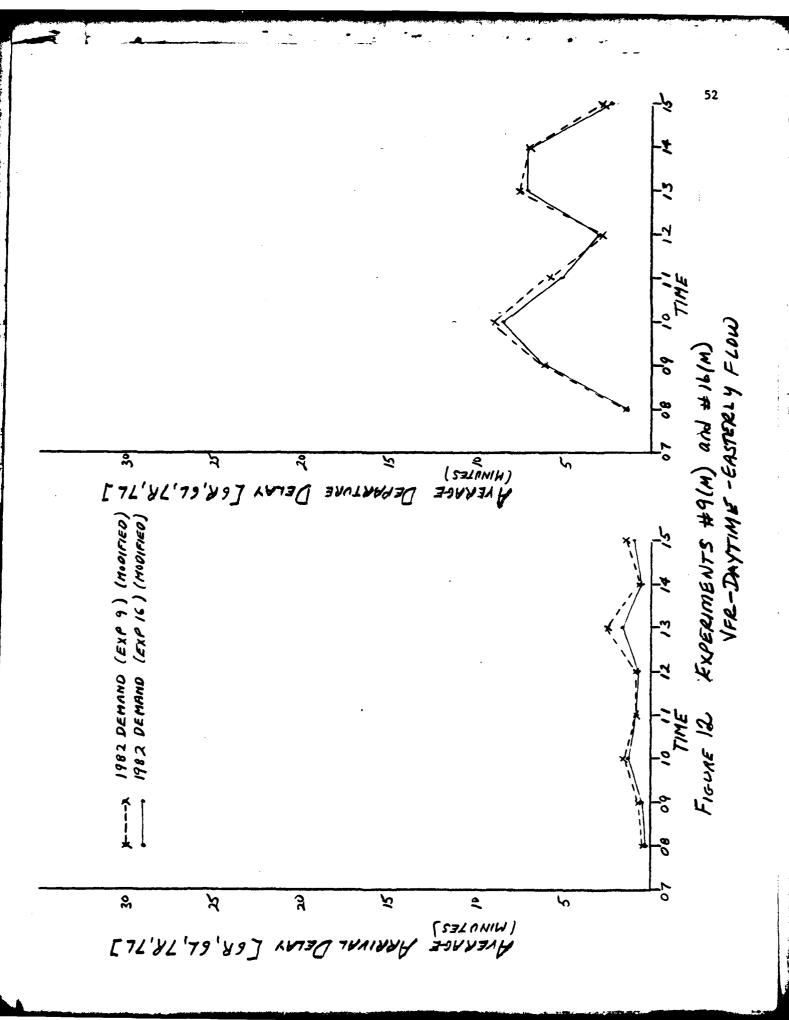
IFR-Daytime-Westerly Flow

The results of the experiments are shown in Figures 10 through 14 and Table 20. The figures show the average delays for arrival and departure runways. Included in the figures are the initial results from experiments #11 and #12 demonstrating the necessity to reroute departures to the north complex when delays start to build on the south runways. The table shows a direct comparison of the experiments and the effects of the improvements on delay and travel times.

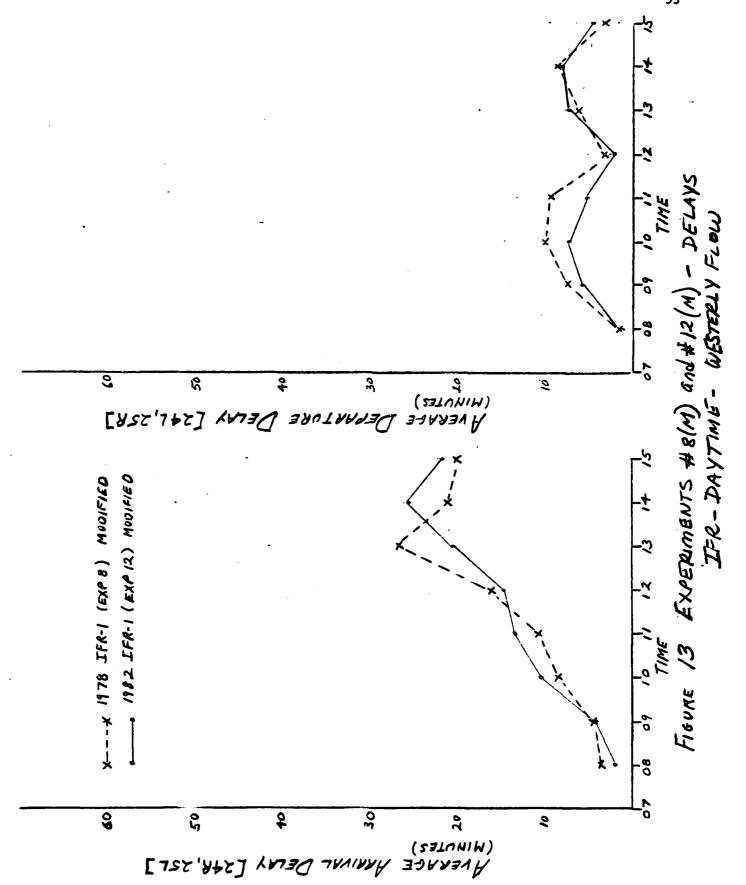
The peak average delay and the annual delay estimates are shown in Tables 21 and 22.











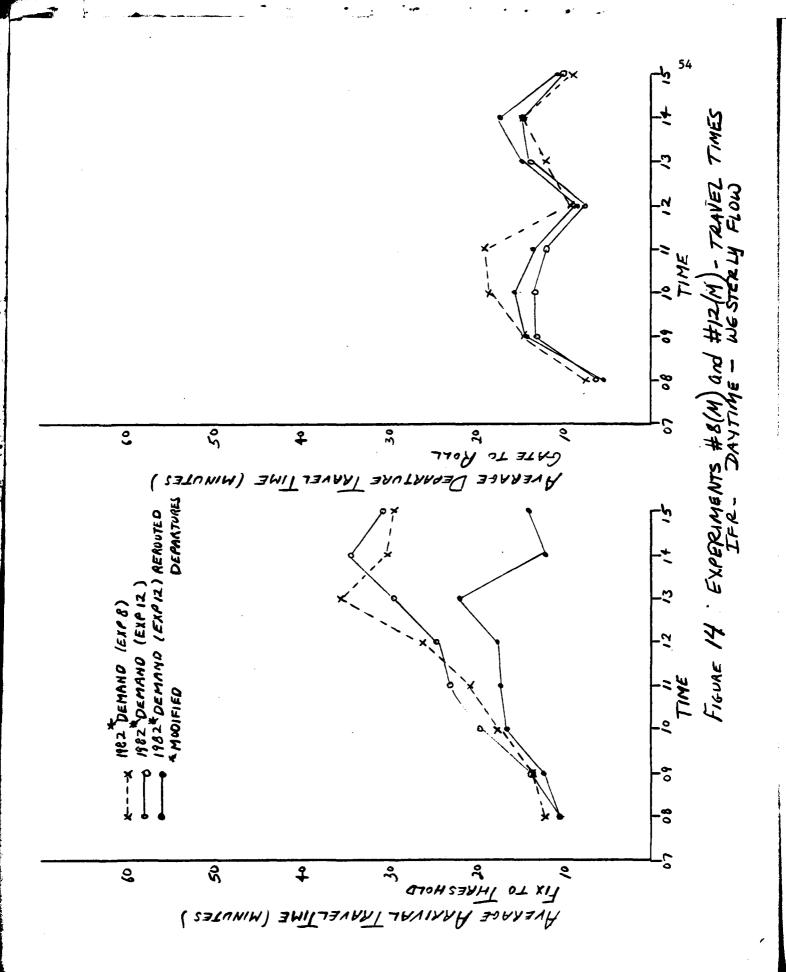


TABLE 20

1982 DO-NOTHING CASE WITH 1982 SEPARATIONS AND NEAR-TERM INPROVEMENTS

	_	T	T	
	TOTAL	11296	00/0/	
(minutes)	Chounts	8 30 3336 4027 1610 5659 11296	6 3106 3797 1501 4801 10100	
W. TINES	ARRIVAL.	1610	1054	
	IR TVAL	4427	3797	
TRAFFIC ARRIVAL DELAY (minutes) DEPARTURE DELAY (minutes) TOTAL	GROUND ARR	3336	3106	
60)	CATE	30	9	delaye
Y (minut	X-ING X-ING	8	80	•perture
URE DELA	TAXI		194	al and de
DEPART	RUMAY	2578	2048	er arriv
stautes)	RUMBAY X-1NG	18	97	d in low
DELAY (TAXI	23	2,8	rosulte
ARRIVAL	RDMAN	643	(NFR) 405 58 87 2048 194	soperations resulted in lower arrival and departure delays.
AIR TRAFFIC	SK PARATIONS	1978 1875 18 72 843 582	1987	1
CHEROVERENTS		NONE	NEAK TEKM	souts and the
EXP. DEMAND ARRIVAL DEPARTURES INPROVEMENTS AIR TR	MODIFIED RESOURED		DEPARTMES SENT FROM 2SR TO 24	RESULTS: The NEAR-TERM improvements and the 1962
ARRIVAL	MODIFIED	1	1	The MEAR-
DENAMB		1982	11 182	sults:
EXP.		7	11	ä

	43 MALINIS	43 MALMAS
408 85 57 2370 406 10	408 85 57 2370 406 10	1982 FRANKES NONE 1978 (VFK) 408 85 57 2370 406 10 67 3342
408 85 57 2370 406	408 85 57 2370 406	408 85 57 2370 406
408	408	408
408	408	408
None 1978 (VFR) 4	43 Milwes None 1978 (VFR) 4	193 Albus 6 None 1978 (NFK) 4
None	43 Allums CHANGE O Except That	193 MALLINGS NOTE
	43 Milms CHANGED FROM THAT	19 Address CHANGES FACTORING
	THE WORLD	1982 Exertited

RESULTS: The high speed exits, rumsy 7L by-pass and the 1982 separations resulted in lower arrival and departure delays.

_	,	,
15470	12515	
5 304 3206 8324 1578 5380 15470	1665 544 12515	
87.81	1665	
8324	290 3307 5406	
3288	3307	
304	290	
h	9	
164	189	
41/2	2713 189	
2	538	
39	50	
(IFR) 5700	[IFR] 232,	
1978 (IFR)	1982 (SFR)	
NONE	NEAN TEAM	•
	1982 CHANNES DEMITTURS 1982 CHANNES ASK TO 24L TO 24K	
40 MMINAS ON 251 50 24 6	50 ANIMAS 073 25 C CHANGEO 70 24 K	
183	1987	
*∞	17,	

RESULTS: The NEAR-TERM improvements and the 1982 separations resulted in lower errival delays.

TABLE 21

PEAK AVERAGE DELAY (AVERAGE DAY) (minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIM ARRIVAL	E DELAY DEPARTURE
7	1982	VFR	NONE	1978	3.5	9.5
11**	1982	VFR	NEAR-TERM	1982	1.6	7.5
8*	1982	IFR	NONE	1978	26.6	10.0
12*	1982	IFR	NEAR-TERM	1982	25.5	8.3
						··· •
						· · · · · · · · · · · · · · · · · · ·
-						

^{* =} Modified Demand

^{** =} Rerouted Departures

TABLE 22
ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNU	AL DELAY (hou	
				ARRIVAL	DEPARTURE	TOTAL
7,8 & 10	1982	none	1978	13,270	26,359	39,630
11,12	1982	NEAR-TERM	1982	4,389	16,646	21,036
	<u> </u>				JAL OPERATIONS	<u> </u>
7,8 & 10	1982	NONE	1978		518	
11,12	1982	NEAR-TERM	1982		518	
				AVERAGE AN	NUAL DELAY () DEPARTURE	minutes) TOTAL
7,8 & 10	1982	NONE	1978	3.1	6.1	4.6
11,12	1982	NEAR-TERM	1982	1.0	3.9	2.4

COMPARISON OF 1978 OPERATIONS WITH 1987 SEPARATIONS AND LONG-TERM IMPROVEMENTS VARYING THE 1987 DEMAND

The basis for comparing the 1978 operations with the 1987 separations and long-term improvements includes the VFR and IFR weather conditions for the westerly traffic flow during the daytime - under demands for 1978, 1987 and 1987 with 10% greater peaks.

EXPERIMENTS

CONFIGURATIONS

(1978, 1987, 1987 with peaks, respectively)

#1, #25 and #25A

VFR-Daytime-Westerly Flow

#2(Modified) and #26

IFR-Daytime-Westerly Flow

The results of the experiments are shown in Table 23. The peak average delays, Table 24, and the estimated annual delays, Table 25, under the various demands (1978, 1987 and 1987 with 10% greater peaks) show substantial improvement in delay.

59

TABLE 23

1978 TELLICHE HITH 1967 SEPARATIONS AND LONG-TERM IMPROVEMENTS VARYING THE 1987 DEMAND

	OTAL	1283	265	138
simutes)	CROWND TOTAL	74 3477 4077 1529 5677 11283	2 1639 3720 1452 3519 8092	73 2524 3819 1505 4455 9859
, TRAVEL TIMES (minutes)	ARRIVAL DE	1529	1452	15.25
TRAY	ARRIVAL A	4077	3720	3819
TOTAL	CROUND ARE	3477	1639	4534
(00	E TI	X	7	7.3
Y (minu	X-ING	7	~	`
URE DELA	TAXT	482	245	415
DEPART	KUMMAY	2792	1325	1957
(minutes) DEPARTURE DELAY (minutes)	X-ING	90	34 32 1325 245	38 1957 415
DELAY (TAXI	46	34	40
ARRIVAL	AIR	803		(VFR) 257 40
AIR TRAFFIC	SE PAKAT LUMS	1978(1FA) BO3 46 BO 2792 982	1987(VFR) 189	1987(VFR)
RIP. DEMAND ARRIVAL. BEPARTURES THPROVENENTS AIR TRAFFIC ARRIVAL DELAY (NoNE	FAR TEKM	FAR TERM
DEPARTURES	ar month	l		ļ
ARRIVAL	HODIFIED		1	
DEMAND		1178	187 25	1901 154 HOT
X.		1	35	15.0

RESULTS: The FAR-TERM improvements and 1987 VPR separations resulted in substantial reductions of arrival and departure delays.

			_
	H755	9920	
	7610 1548 5597 14755	0104	
	1578	1577	
	0/92	2150 4392 1577	
	315 3437	2/50	
	3/5	79	
	+	7	
	128	88	
	2895 128	1933	
	0	35 1123	
	35	23	
	4444	831	
	1978 (IFR)	1987(IFR)	
	NoNE	FAR TERM	
	1	{	
44 Addivas	24 25 L		
	82.11	1891	
•	~	77	

assents: The FAR-TERM improvements and 1987 IFR separations resulted in substantial reductions of arrival and departure delays.

- Madified Demand

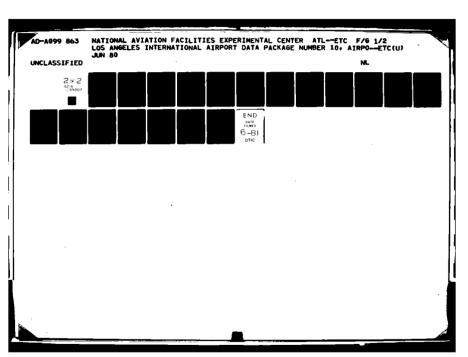


TABLE 24

PEAK AVERAGE DELAY (AVERAGE DAY) (minutes)

EXP	DEMAND	WEATHER	IMPROVEMENTS	SEPARATIONS	DAYTIM ARRIVAL	E DELAY DEPARTURE
1	1978	VFR	NONE	1978	5.3	10.6
25	1987	VFR	FAR-TERM	1987	0.6	5.0
25A	with 1987peaks	VFR	FAR-TERM	1987	0.9	7.9
2_	1978	IFR	none	1978	25.7	12.5
26	1987	IFR	far-term	1987	4.6	7.0
					-	
			,			
				•		•
		·				

TABLE 25

ANNUAL DELAY ESTIMATES

EXP.	DEMAND	IMPROVEMENT	SEPARATION	ANNU	IAL DELAY (hor	urs)
			· · · · · · · · · · · · · · · · · · ·	ARRIVAL	DEPARTURE	TOTAL
1,2 & 4	1978	none	1978	11,485	26,505	37,991
25,26	1987	FAR-TERM	1987	2,148	11,348	13,496
					JAL OPERATIONS TAL X 1000	S
1,2 & 4	1978	NONE	1978		510	
25,26	1987	FAR-TERM	1987		527	
	į			AVERAGE AN	NUAL DELAY (1	nimutes) TOTAL
1,2 & 4	1978	NONE	1978	2.7	6.2	4.5
25,26	1987	FAR-TERM	1987	0.5	2.6	1.5

COMPARISONS OF SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

The basis for comparing the possible sequences of tunnel construction activities includes: the availability of the dual taxiway during the closure of runway 25R during VFR weather with and without the completion of runway 25L, and the closure of a runway (25R or 25L) during IFR weather with and without the completion of the other runway.

EXPERIMENTS	CONFIGURATIONS
(Do-nothing and activity, respectively)	
#7 and #22A	VFR-Daytime-Westerly Flow
#7 and #22(rerouted)	VFR-Daytime-Westerly Flow
#22(rerouted) and #35(rerouted)	VFR-Daytime-Westerly Flow
#8(modified) and #23(rerouted)	IFR-Daytime-Westerly Flow
#8(modified) and #24(rerouted)	IFR-Daytime-Westerly Flow
#23(rerouted) and #36(rerouted)	IFR-Daytime-Westerly Flow
#24(rerouted) and #37(rerouted)	IFR-Davtime-Westerly Flow

The results of the experiments are shown in Table 26. There is a series of experiments performed under both VFR and IFR weather conditions in which runway 25R is closed for tunnel construction, and then after its completion, runway 25L is closed. Under IFR weather conditions, there

is a sequence of experiments in which runway 25L is closed for tunnel construction, and then, after its completion, runway 25R is closed.

The effect of the dual taxiway during tunnel construction on 25R, under VFR conditions, is shown in experiment #22A.

64

TABLE 26

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

캭	_[5	(minut	1	TOTAL	TRA	VEL THES	TRAVEL TINES (minutes)	
TAX1 KUMAAT	MUMAY	TWI TWI	RUMAY X-THG	SATE	CROUND	ARRIVAL Atr	ARRIVAL Ground	de Partures Ground	LOLVE
57 81	25%	57.5	0	30	33.36	4027	0/9/	65.25	96211
233 //	4200	1450	*	446	6857	4403	3100	2808	15586
187 /6	407/	13.59	*	1048	1699	***	7101	100%	18.247
65 10	2925	800	0	50	3849	4340	1653	61.59	12/53
truction resulted in larger departure delays (about 56%). he dual taxiway system during tunnel construction reduced the taxi delays. truction affer the completion of runway 25% resulted in less delay compared to the delays runway 25% (Experiment #22).	arture dele unmel consi f runway 2	iya (abo iruction M resul	reduced ted in l	the ta	ti delaye ty compan	red to the	delaye	:	
39 63	27/4	49/	4	304	32.88	8324	1578	825.5	15470
131 17	5292	33,	^	1318	9946	7353	1757	11543	20452
8/ /4	5375	#	0	3339.	3153	93.19	1527	11028	21873
largar depo	erture dela of runway	ys durin 25g, resu	E IFR villed in	pather. higher	errive)	delays (d	ue to the		
	63 /7 /4 /4 mplerion	63 27/4 /7 5292 /4 5375 rger departure dala epletion of runus	63 2714 164 17 5292 331 14 5375 344 rgar departure delays duris	63 2714 164 5 17 5292 331 7 14 5375 344 0 rgar departure delaye during IFR wepletion of runway 258, resulted in	(IFR) 5700 39 63 2714 164 5 304 (IFR) 4776 131 17 5292 331 7 4318 YFRI (247 81 14 5375 344 0 3339 Eruction resulted in larger departure delays during IFR weather. struction, after the completion of runway 25g resulted in higher than Experiment #23.	63 27/4 164 5 304 3298 17 5292 331 7 43/8 9946 14 5375 344 0 3339 9/53 rgar departure delays during IM weather. expletion of runway 25% resulted in higher errival	63 27/4 164 5 304 3298 8524 17 5292 331 7 4318 9946 7353 14 5375 344 0 3339 9153 9319 1501 departure delays during IPR wather. mpletion of runsay 25g, resulted in higher arrival delays (a	328 8524 9946 7353 9153 9319 arrivel delays (du	328 8524 1578 9946 7353 1757 9153 9319 1527 1

* - Modified Demand

65

TABLE 26 (CONTINUED)

(MINITURE) AT THE

SEQUENCES OF TUNNEL CONSTRUCTION ACTIVITIES WITH 1982 DO-NOTHING CASE

EXP.	DEMAND	VALUE	DEPARTURES	EXP. DEMAND ARRIVAL DEPARTURES INCROVEMENTS AIR	AIR TRAFFIC	ARRIVAL	DELAY (4	(Puntes)	DEPART	URE DELA	Y (minut	•	TOTAL	TEA	VEL TIMES	(minutes)	
		MODIFIED	REPOUTED		SEPARATIONS BUNMAY TAXI RUMMAY TAXI TUMMAY GATE CROUND ARRIVAL GREEVE GROUND CROUND CROUND CROUND CROUND CROUND	RUMMAY	TAXI	X-ING X-ING	RUMBAY	TAXI	X-INC X-INC	GATE	GROUND	CROUND ARRIVAL ARRIVAL DEPARTU DELAYS AIR GROUND GROUND	ARATVAL GROUND	DR PARTURES GROUND	TOTAL
* 49	1982	1982 ON 356	_	ZNON	1978 (IFR) 5100	5700	39	39 63 274 164	27 H	<i>+91</i>	ک	304	3283	5 304 3233 8324 1573	1578	1	5568 15470
24	24 1982		DEPHATURIS SENT FROM 25 R PL 29 L	DEPINITALS RUNWAY 25L SENT FROM TUNNEL 25R P. 29L CONSTRUCTION	(771) STP1	5043	. 173	20	6420	394	0	4872	11479	2298	1161	(ITR) 5043 173 20 6020 394 0 4872 11479 8626 1911 13505 36557	36557
37	1887	So Ankains on 254 c. Hange e 9 10 248	DEPHYTMES SENT FROM 25K TO 24L	37 MB2 ON 254 SENTENDE ROUND STATE SENTENDE STATE STAT	(१७६५)	1535	95	151	5493	328	*	35/2	9954	6166	763/	11664	23079
1	N.TS:	Experiment (Experiment Experiment Experiment	iment #24 Burner riment #24 compai runneny 258.) iment #37 Burner the use of runner	AESULTS: Experiment #24 Runsay 25L tunnel construction (Experiment #24 compared to Experiment #23 indic runsay 25R.) Experiment #37 Runsay 25R tunnel construction, the use of runsay 25R tunnel Experiment #24.	construction ment #23 indi construction perfeent #24	truction resulted in larger departure delays during IFR weather. F23 indicated that the construction of runway 25L produced large truction, after the completion of runway 25R, resulted in higher and \$24.	t the compl	er depar pastructi etion of	ture deli	ays durf men 25L 25R, res	ng IFR w produce	eather. d larger higher	delays t	hen the i	Initial co	firstion resulted in larger departure delays during IFR weather. 23 indicated that the construction of runway 25L produced larger delays than the initial construction of truction, after the completion of runway 25R, resulted in higher arrival delays (due to the demand for ant #24.	of

COMPARISON OF 1982 SEPARATIONS AND DUAL TAXIWAY IMPROVEMENT WITH 1982 DO-NOTHING CASE

The basis for determining the effect of the dual taxiway on delays and travel times includes a comparison of the 1982 do-nothing case (experiment #7) with experiment #18 (1982 separations with dual taxiway). Both experiments have identical 1982 demands.

EXPERIMENTS

CONFIGURATION

(Do-nothing vs. separations and taxiway)

#7 and #18

VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 27.

COMPARISON OF NEAR-TERM IMPROVEMENTS WITH DUAL TAXIWAY IMPROVEMENT

The basis for determining the percentage (%) of reduction of departure ground travel times for the near-term improvements includes a comparison of experiments with 1982 demands and 1982 separations. Experiment #18 (rerouted) has a dual taxiway improvement and experiment #11 (rerouted) has the near-term improvements (tunnel construction, by-pass around 24L to runway 24R, high speed exit from runway 25L to the south, etc.). These experiments, similar in demand and separations, permit isolation of the effects of the near-term improvements since a previous comparison has shown that the dual taxiway shows no improvement under the 1982 demand.

EXPERIMENTS

CONFIGURATION

(Dual taxiway and near-term, respectively)

#18(rerouted) and #11(rerouted)

VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 27.

COMPARISON OF DEPARTURE BY-PASS AROUND RUNWAY 24L WITH DUAL TAXIWAY IMPROVEMENTS

The basis for determining the percentage (%) of improvement for the departure by-pass around runway 24L to runway 24R involves a comparison of experiment #13 with experiment #18 (dual taxiway improvement). Since both experiments have identical 1982 demands and 1982 separations and a previous comparison shows no improvement due to the dual taxiway for the 1982 demand, this comparison isolates the effect of the by-pass.

EXPERIMENTS

CONFIGURATION

(Dual taxiway and by-pass, respectively)

#18 and #13

VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 27.

TABLE 27 IMPROVEMENT COMPARISONS

EXP.	DEMAND	ARRIVAL.	DEPARTURES	I MPROVEMENTS	ATR TRAFFIC	ABRIVAL	DPIAY (.	of market	De PA BT	ATAN BOIL	Y (market)		TOTAL	ľ	100	1000000	
		DEPAND HODI FIRD	REROUTED	DEPARD RESOUTED SEPARATIONS RUMBAY TAXI RUMBAY CATE CROWND HODIFIED X-ING X-ING X-ING X-ING	SEPARATIONS	RUMMAY	TAXI	RUNKAY X-ING	BUNNAY	TAXI	RUNNAY X-114C	GATE	CROUND ARRIVI	KRRTVA Kir	RRIVAL JARATVAL DEPARTI	L ARATVAL DEPARTURES TOTAL	TOTAL
7	1982	·	ı	NONE	1978 (VFR)	14K) 643 57 BI 2598 562	57	18	2598	295	8	30	3336	7	16/0	5659 11296	11296
æ	18 1182			LYXIMUX DOUT	1802(VFR) 516 48 59 2626 561	2/16	48	5.3	9092	256/	6	27	3337	3914	1623	27 3331 3914 1623 5705 11242	11242
		1	,		,												

RESULTS: The dual taxiway ayetem and the 1982 separations resulted in raduced arrival delays. No change was noted in the taxi delays.

10759	00/0/	
31 2911 3786 1625 5349 10759	3106 3797 1501 4801 10100	
1625	1051	
3786	3797	
7361	3/06	
31	9	
0/	8	
485	444	
60 2277 485 10	2048 494	
09	1	
48	8.5	
382	405	
M82(VFK)	1862(VFR) 405 58 87	
DUAL TAXIWAY	NEM TERM	
DEPARTURES SENT FROM 25A TO 24A	"	
1682	1982	
18	11	

RESULTS: The MEAL-TERM improvements resulted in reduced departure delays.

٢																	
	1962	ı	,	DUAL TAKIWAY	1982(VFR)	3//5	43	53	195 3292	561	6	77	333/	3331 3914 1623	1623	2705 11242	11242
	1987		-	BY-PASS TO RUNWAY 29A HOLDING MED	1982(VFR) 43G	436	19	88	2360	468	8	21	3026 3828	3828	1/9/	5304 10742	10742

RESULTS: The by-pass to runway 24R and the holding area on taxiway 75 resulted in reduced departure delays.

COMPARISON OF 1982 DO-NOTHING CASE WITH 1982 SEPARATIONS, HIGH SPEED EXITS OFF OF RUNWAYS 6R and 7L, AND DEPARTURE BY-PASS AROUND RUNWAY 7L

The basis for determining the effect on delays and travel times of the 1982 separations, the high speed exits off of runways 6R and 7L, and the departure by-pass around runway 7L to runway 7R includes a comparison of experiments #6(M), #9(M) and #16(M). Experiment #6 (with modified arrival demand) is the base case with 1978 separation values. Experiments #9(M) and #16(M) have the 1982 demand (with modified arrival demand) but differ with respect to the improvements noted above

EXPERIMENTS

CONFIGURATION

(1978, do-nothing and improvements respectively)

#6(M), #9(M) and #16(M)

VFR-Daytime-Easterly Flow

The results of these experiments are shown in Table 28.

TABLE 28

1982 DO-NOTHING CASE WITH 1982 SEPARATIONS, HIGH SPEED EXITS OPF RUMANYS 6R AND 7L, AND DEPARTURE BY-PASS AROUND RUMANY 7L

X.	DEMAND	ARRIVAL	DEPARTURES	EXP. DEMAND ARRIVAL DEPARTURES THPROVEHENTS AIR TR	AIR TRAFFIC	ARRIVAL.	DELAY (.	dautes)	DEPART	URE DELA	Y (minut	(3)	TOTAL	TRA	VEL TIMES	(minutes)	[
		DEMAND HODIFIED	REROUTED		SEPARATIONS	RUNGAY	TAXI	RUNAAY X-ING	RUNHAY	TAXI	RUNNAY X-ING	GATE	GROUND ARRIVAL DELAYS AIR	ABRIVAL AIR	ARRIVAL	ATIONS RUNMAY TAXI RUNMAY RUNMAY TAXI RUNMAY GATE CROUND ARRIVAL DEPARTURES TOTAL X-ING X-	TOTAL
*9	1178	71 3 6.1 71 37 10 V J 73 3 2 V V V V V V V V V V V V V V V V V	1	NoNE	1978 (VFA) 460		991	42	166 42 2546 606	909	0	384	3745	3969	/63/	0 384 3745 3989 1631 6017 11638	11638
9*	1982	1982 FAM TAS TO TE EL	-	NoNE	1978 (VFR) 408 85 57 2370 406 10 67 3302 3985 1595 5072 10652	408	65	52	2370	406	९	19	3302	3985	1595	5072	10652
16,	16 1982	"		BESTS, BURNING 19 BZ VFR) 332 76 62 2271 309 13 65 2795 3878 1602 4898 10399	19 BZ(VFR)	332	7,6	29	12271	309	ي د	65	2795	3878	7607	4878	10599

RESULTS: Experiment 9-- The 1982 demand resulted in reduced arrival and departure delays due to the change in the sircraft mix and and the distribution of the air traffic demand over the runways.

Experiment 16-- The 1982 demand, the high speed exits and the runway 7L by-pass showed an even greater reduction in arrival and departure delays than did Experiment 9.

* - Modified Demend

COMPARISON OF 1982 DO-NOTHING CASE WITH TERMINAL EXPANSION AND THE PRESENCE AND ABSENCE OF 1982 SEPARATIONS

The basis for determining the effect of terminal expansion (with and without the 1982 separations) on delays includes a comparison of the 1982 do-nothing case (experiment #7) with experiments #19A and #20. All of these experiments have 1982 demands.

EXPERIMENTS

CONFIGURATION

(Do-nothing vs. expansion vs. expansion and separations, respectively)

#7, #19A and #20

VFR-Daytime-Westerly Flow

The results of these experiments are shown in Table 29.

TABLE 29

1982 DO-WOTHING CASE WITH TERMINAL EXPANSION AND THE PRESENCE AND ABSENCE OF 1982 SEPARATIONS

Г	L	<u>,</u>	3	1.0	T
].,	TOTAL	1/29	1058	1076	
(minutes)	DEPARTURES CROUND	5657	(VTR) 525 39 45 2346 424 8 12 2873 3023 1586 5157 10580	5357	
VEL TIMES	ARRIVAL DEPARTU GROUND GROUND	9/9/	1586	1634	
JT.	GROUND ARRIVAL DELAYS AIR	4027	5823	3761	
TOTAL	GROUND	3336	2873	3084	
(66)	CATE	30	12	52	
Y (minu	RUNNAY X-1MC	80	8	80	
URE DEL	TAXI	57.2	424	432	
DEPART	BUNKAY	25%	2346	2494	
dautes)	RUMMAY X-ING	18	45	23	
DELAY (1XVI	25	33	48	
ARRIVAL.	RUNNAY	643	525	420	
AIR TRAFFIC	SEPARATIONS	1978(VR) 643 57 81 2598 582 8 30 3336 9027 1616 5657 11296	(978 (VFR)	1982(VFR) 420 +8 51 2494 432 8 52 3084 3781 1634 5351 10766	1
EXP. DEMAND ARRIVAL DEPARTURES THPROVEMENTS ATR TRAFFIC ARRIVAL DELAY (minutes) TOTAL , TRAVEL TIMES (minutes)		3NoN	TERMIMAL EXPANSION	TE KNUNAL ESPANSION	PROPERTY Transform Township Avenue and Authority Avenue and Authority an
BEPARTURES	REMOUTED	_			194 42
ARRIVAL	DENAND MODIFIED	-			Pynerine
DEMAND		7 1102	194 1982	2361 02	911 76.
EXP.		7	191	70	-

in departure delays due to the distribution of the air traffic demand

Experiment 19A-- Istminat expensive recovers the control of the control and departure delays compared to Experiments 7 and 19A. Experiment 20-- Terminal expansion with 1982 separations resulted in reduced arrival and departure delays.)

(Experiment 20 had the lowest arrival delays and Experiment 19A had the lowest departure delays.)

COMPARISON OF REMOTE TERMINAL WITH DUAL TAXIWAY IMPROVEMENT

The basis for determining the effect of a remote terminal improvement includes a comparison of experiments with 1982 demands and 1982 separations. Experiment #21 has a remote terminal added for international flights and a new distribution of traffic to and from the gate areas. Since experiment #18 (with the dual taxiway system) showed no improvement over the 1982 donothing case, a comparison of experiments #18 and #21 isolates the effect of the remote terminal.

EXPERIMENTS

CONFIGURATION

(Dual taxiway and remote terminal, respectively)

#18 and #21

VFR-Daytime-Westerly Flow

The results of this comparison are shown in Table 30.

TABLE 30

RENOTE TERMINAL WITH DUAL TAXIMAY IMPROVEMENT

	$\overline{}$	T -	T :
	TOTAL	11242	58111
(minutes)	CROMM TOTAL	27 5331 39th 1623 5705 11242	28 3398 3845 1590 5749 11185
TEL TIMES	GROUND GROUND	/623	15%0
AT.		39.14	3845
TOTAL	NUMBAY TAXI RUNBAY GATE GROUND ARRIVA	333/	33%
(00)	CATE	77	28
Y (minut	RUNIAY X-THG	٥	9
URE DELA	TAXI	125	288
DEPART	MUMMAN	125 9292 65 84	2668
inutes)	K-ING X-ING	52	S
DELAY (IUMAY TAXI	\$	46
MAFFIC ARRIVAL DELAY (minutes)	RUNGAY	216	(VFR) 440 46 63 2168 588
AIR TRAFFIC	SEPARATIONS R	19 BZ(VFR) 516	1982
EXP. DEMAND ARRIVAL DEPARTURES THEROVENERS ATE TR		OUML THXIWMY	REMOTE TEKNINAL
DEPARTURES	DEMAND RENOUTED HODIFIED		1
LERIVAL	DEMAND HODIFIED		
DEHAND	- 2	18 1102	23 1982
EXP.		18	17

RESULTS: The remote terminal resulted in reduced arrival delays and alightly increased departure delays.

2.5. Analysis of Results (interpretation)

The results of the experiments performed under the delay studies of the Los Angeles International Airport Task Force have demonstrated the relationship of air traffic demand and delay, and identified the delay reduction benefits of various near-term and far-term improvements.

Several performance measurements have been introduced to indicate the changes which occur as improvements are introduced into both the air traffic control scenario and the airport design. These measures include the peak average delays, the annual delay estimates, the total delays and the travel times during a simulated time period. They are calculated under different estimates of air traffic demand and operating conditions.

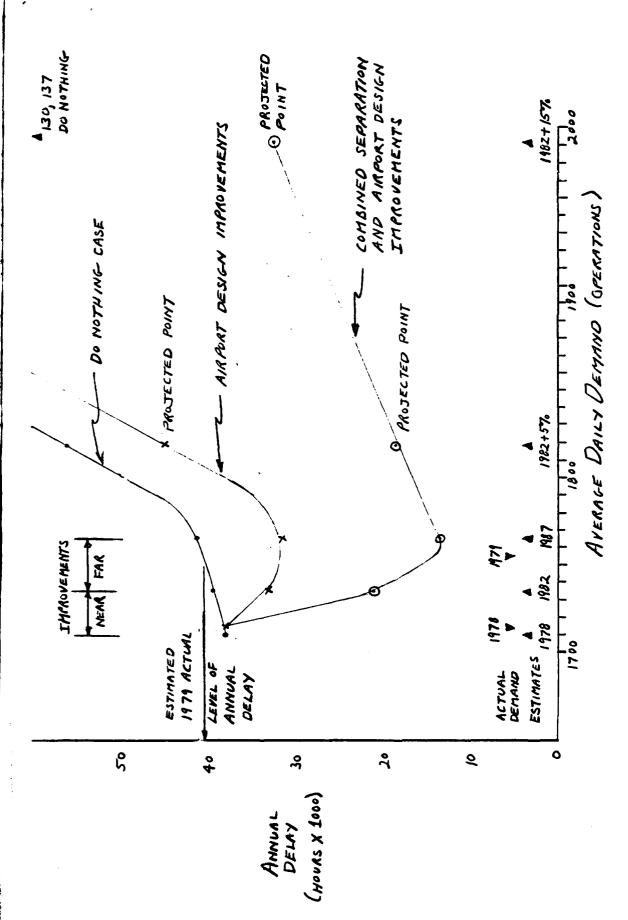
In addition, the estimated demands are periodically compared with the actual demand encountered at the facility.

Table 31 is a summary of annual delay estimates for the various demands, the ATC system scenarios and the improvements. The results are plotted in Figure 15 to illustrate both past and present operating conditions at the airport. Projected points on the curves are calculated using the percentages of improvement in delay attributed to the near-term or far-term conditions of both the ATC scenario and the airport design. Markers are set on the scale to show the actual demands encountered in 1978 and 1979.

TABLE 31

SUMMARY OF ANNUAL DELAYS (ESTIMATES)

DEMAND	ATC SYSTEM SCENARIO	IMPROVEMENTS	ANNUAL DELAY (HOURS)
1978	1978	none	37,991
1982	1978	none	39,630
1982 + 5%	1978	none	56,289
1982 +15%	1978	none	130,137
1982	1982	none	33,953
1982	1978	1982	33,150
1982	1982	1982	21,036
1987	1978	none	41,339
1987	1978	1987	31,500
1987	1987	none	13,496
1987	1987	1987	13,496



SUMMARY OF ANNUAL DELAY ESTIMATES FIGURE 15